113

NBSIR 73-146

Outdoor Performance of Plastics X. Final Update of Weathering Data

Walter J. Rossiter, Jr.

Center for Building Technology
Institute for Applied Technology
National Bureau of Standards

March 1973

Final Report

Prepared for
Manufacturing Chemists Association
1825 Connecticut Avenue, N. W.
Washington, D. C. 20009

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OURDOOR PERFORMANCE OF PLASTICS
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U. S. DEPARTMENT OF COMMERCE, Frederick B. Dent, Secretary
NATIONAL BUREAU OF STANDARDS, Richard W. Roberts, Director

Abstract

Twenty plastics samples have been weathered in Arizona, Florida, and Washington, D. C. for 72 months. The weathering of these samples has been followed by measuring changes in the specimen's color, tensile, flexure, gloss, and haze properties. Computer-generated graphs of these changes with time are presented.

This is the final updating of the Manufacturing Chemists' Association's (MCA) project which studied the outdoor performance of plastics. Since 1966, twenty plastics samples (Table I) have been exposed outdoors at three different exposure sites (Table II) which represent varying climatic conditions encountered in the United States. The MCA project and preliminary results have been described in a series of National Bureau of Standards Reports. These reports [1-9]*, all entitled Outdoor Performance of Plastics, have the following subtitles:

I. Introduction and Color-Change [1].
II. Tensile and Flexural Properties [2].
III. Statistical Model for Predicting Weatherability [3].
IV. Significance of Climate [4].
V. Surface Roughness [5].
VI. Electrical Properties [6].
VII. Haze and Gloss [7].
VIII. First Update of Weathering Data [8].
IX. Second Update of Weathering Data [9].

Changes in those properties listed in the above subtitles were the means for determining the outdoor performance of the twenty samples. A computer was used for data storage and retrieval. Graphs of property vs. outdoor exposure time were generated by the computer. These graphs were reproduced in the various reports as the method of reporting property changes.

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* Numbers in brackets refer to references which are found in the back of this report.

From the preliminary results, it was decided that color, tension, flexure, gloss, and haze would be the significant properties to follow for the remainder of the project. The samples remaining have now been exposed outdoors for 72 months. These five properties have been measured for each plastic. The physical testing was again performed by MCA member companies (Table III), and the test results sent here to the National Bureau of Standards for incorporation with the earlier data. Although these data were originally reported in three separate NBS reports [1, 2, 7], the data through 72 months for the five properties are all presented in this single report.

Experimental details are not given here; such details can be found in the earlier reports. Again, the data are presented as reproductions of the computer-generated graphs (Figures 1-81B). These graphs differ from the earlier ones in that the X-axis (time in months) has been expanded to 72 months. Thus, the data points are compressed when compared to those of the original graphs.

This report includes all previous data. Some plastics have failed in the field and obviously there are no additional data for these samples. Graphs with the expanded time have been reproduced for those samples for which there are no additional data. This report is meant to be a replacement for the two previous supplemental ones [8, 9]. The weathering of the plastics can be followed without reference to them. The graphs are identical except for the additional data.

The color data presented in the first report [1] were erroneous. These data were corrected in the first supplemental report [8]. No comparisons can be made between the graphs for color change in the first report and any of the updates.

This report is only intended as a presentation of the new data. No discussion of the accumulated data is presented.

References

[1] "Outdoor Performance of Plastics. I. Introduction and Color-Change", J. E. Clark, N. E. Green, and P. Giesecke, NBS Report #9912, Sept. 1968.

[2] "Outdoor Performance of Plastics. II. Tensile and Flexural Properites", J. E. Clark, G. E. Gulmer, R. C. Neuman, and J. A. Slater, NBS Report #10014, March 1969.

[3] "Outdoor Performance of Plastics. III. Statistical Model for Predicting Weatherability", J. E. Clark and J. A. Slater, NBS Report #10016, Oct. 1969.

[4] "Outdoor Performance of Plastics. IV. Significance of Climate", J. E. Clark and C. Bal Krishna, NBS Report #10156, Jan. 1970.

[5] "Outdoor Performance of Plastics. V. Surface Roughness", J. E. Clark, C. Bal Krishna, H. C. Gunst, and J. R. Dagon, NBS Report #10179, March 1970.

[6] "Outdoor Performance of Plastics. VI. Electrical Properites", J. E. Clark, J. A. Slater, and V. L. Bergeron, NBS Report #10185, March 1970.

[7] "Outdoor Performance of Plastics. VII. Haze and Gloss", J. E. Clark, C. Bal Krishna, G. C. Claver, and F. H. McTigue, NBS Report #10188, March 1970.

[8] "Outdoor Performance of Plastics. VIII. First Update of Weathering Data", W. J. Rossiter, Jr. and W. D. Hayes, Jr., NBS Report #10479, September 1971.

[9] "Outdoor Performance of Plastics. IX. Second Update of Weathering Data", W. J. Rossiter, Jr., NBS Report #10856, May 1972.

Table I

List of Twenty Plastics

Base Polymer	Plastic
Polyethylene	Translucent - 1 mil - 60 mil
Poly (methyl methacrylate)	Clear - 60 mil
Poly (vinyl fluoride)	Clear - 1 mil
Poly (ethylene terephthalate)	Clear - 5 mil
Polyester/x-linked	Clear - 60 mil
Poly (vinyl chloride)	Clear - 4 mil - 10 mil - 60 mil Ba-Cd
	Clear - 4 mil - 10 mil - 60 mil Sn
	Clear - 60 mil White - 4 mil - 10 mil - 60 mil Ba-Cd
	White - 4 mil - 10 mil - 60 mil Sn
	White - 60 mil

Table II

Exposure Sites

Name and Location*	Letter Designation for Graphs
Desert Sunshine Exposure Tests, Inc. Phoenix, Arizona	A
South Florida Test Service, Inc. Miami, Florida	F
Old NBS Site Connecticut & Van Ness Streets Washington, D. C.	W

* Samples were placed on the exposure racks facing south at 45° from the horizontal.

Table III

Plastics Evaluation

Property	Company & Location
Color	American Cyanamid Company Stamford, Connecticut
Tensile Flexure	W. R. Grace & Company Clarksville, Maryland
Haze	Monsanto Company Indian Orchard, Massachusetts
Gloss	Hercules Incorporated Wilmington, Delaware

List of Figures

Numbers	
1 - 20	Color-change, ΔE (Delta E)
21 - 40	Ultimate Elongation (% of Initial Value)
41 - 48	5 Percent Stress (PSI)
49 - 68	Gloss (in percent)
69A - 81A	Haze at 421 nm (in percent)
69B - 81B	Haze at 550 nm (in percent)

FIGURE 1

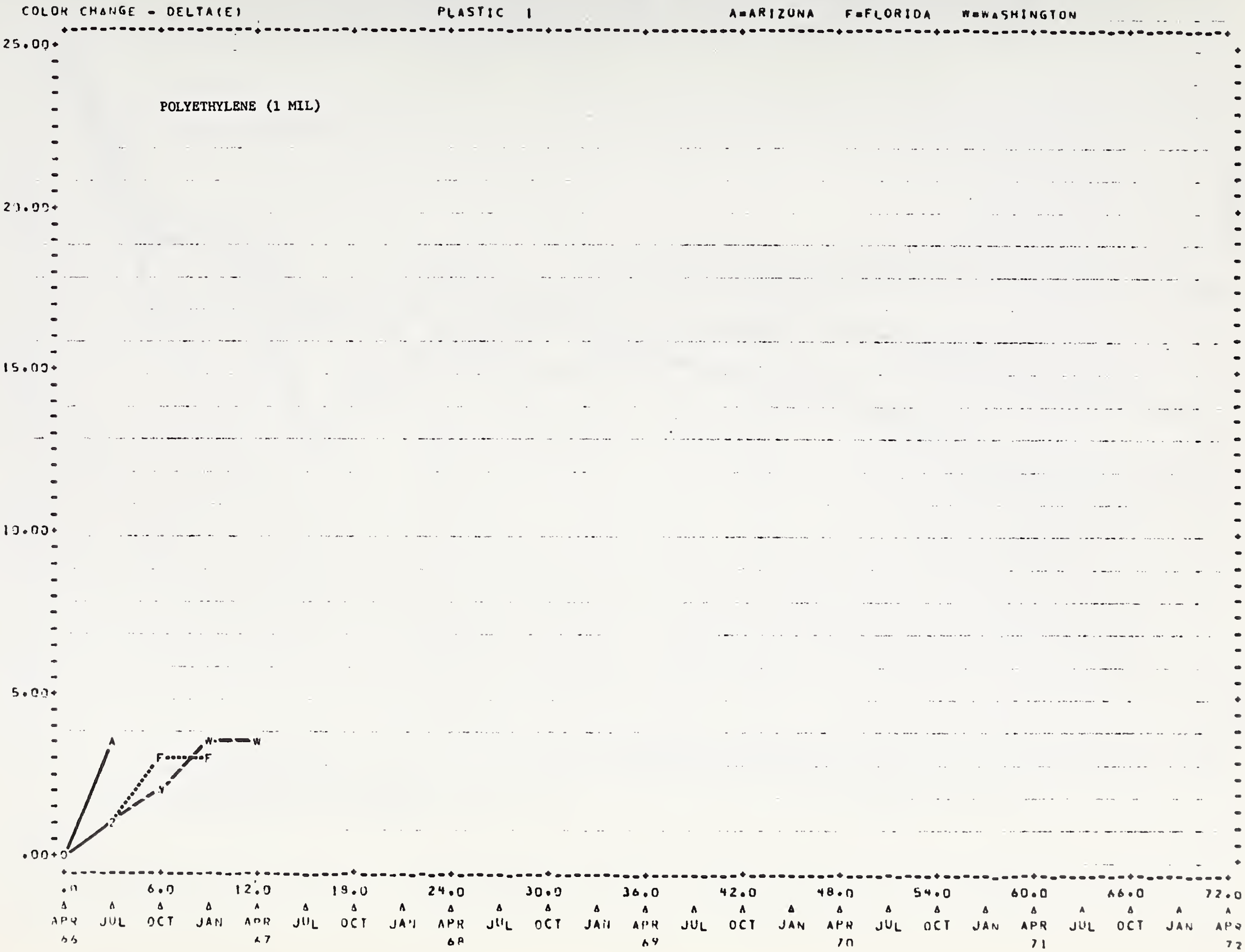

COLOR CHANGE - DELTA(E)
PLASTIC 1
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYETHYLENE (1 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
F
W
W

FIGURE 2

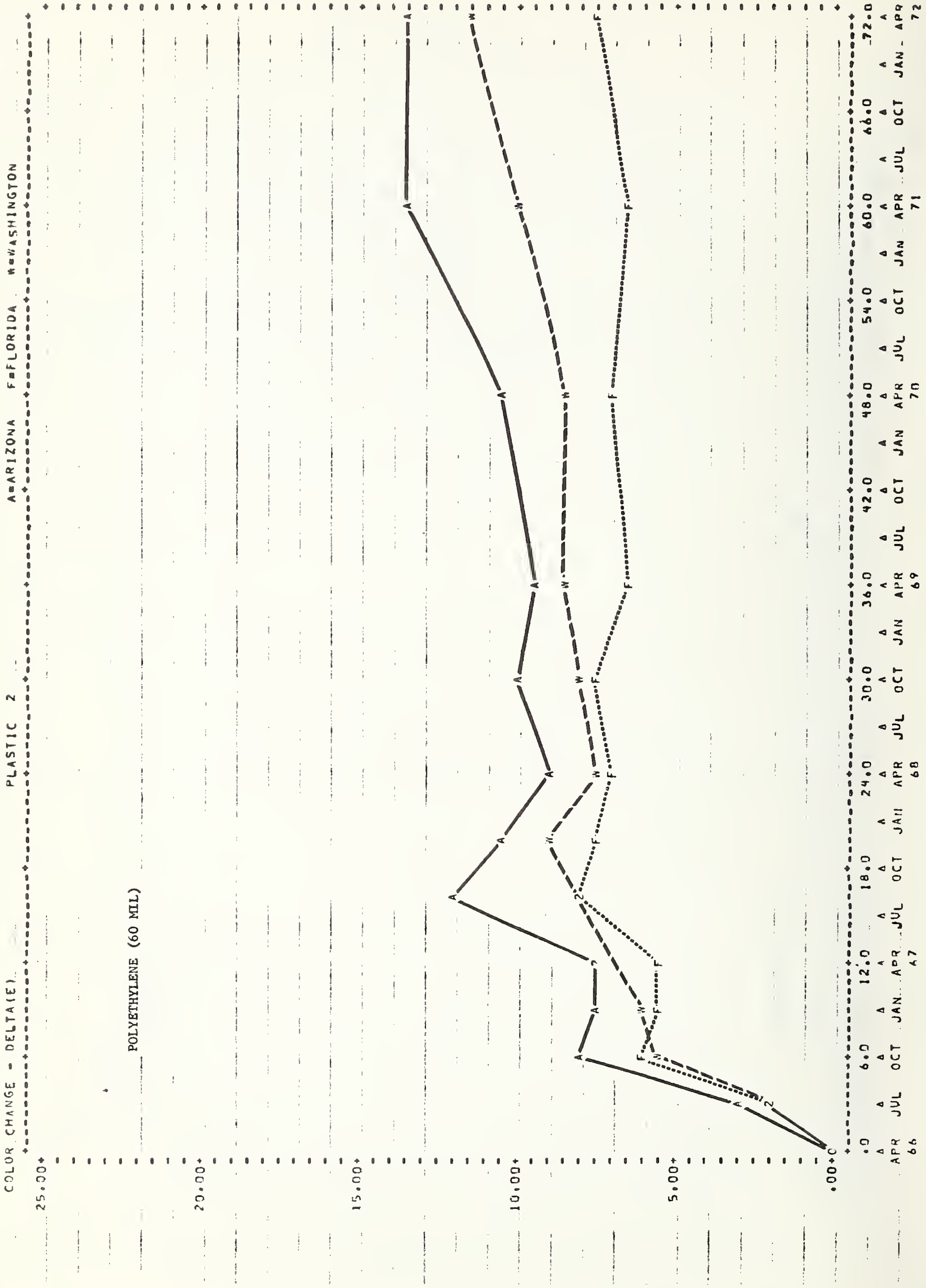

COLOR CHANGE - DELTA(E)
PLASTIC 2
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYETHYLENE (60 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
W
2
C

FIGURE 3

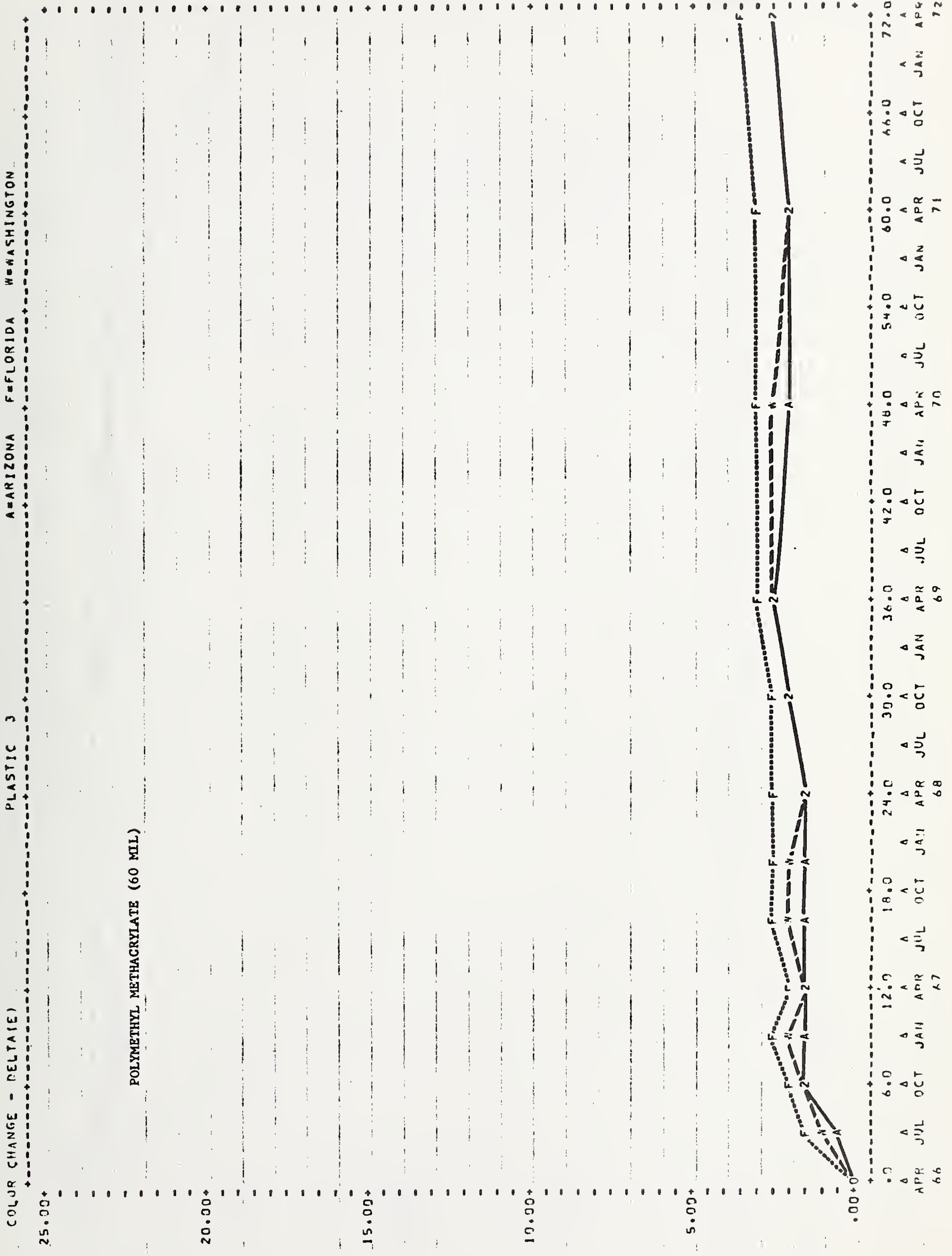

COLOR CHANGE - DELTA(E)
PLASTIC 3
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYMETHYL METHACRYLATE (60 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 4

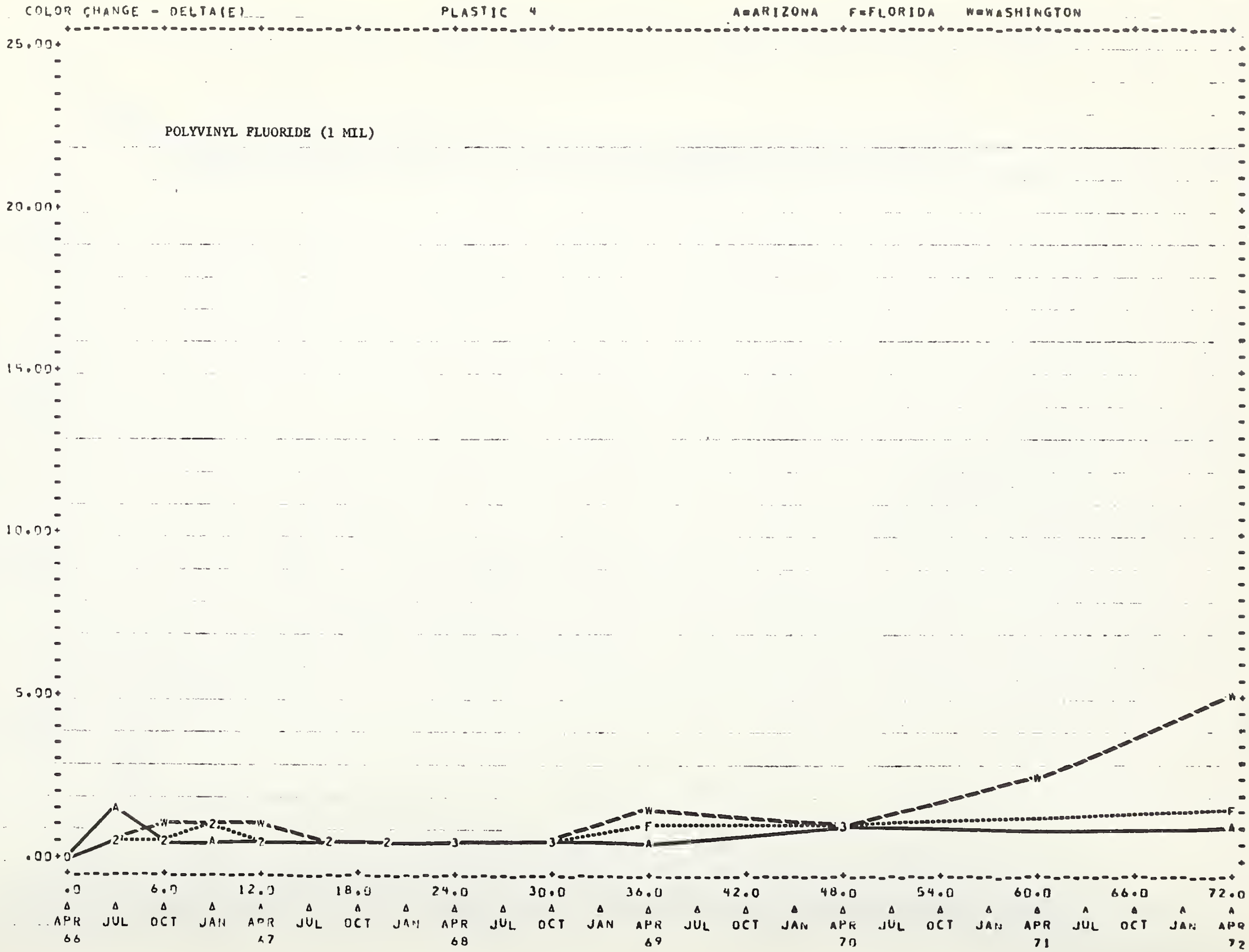

COLOR CHANGE - DELTA(E)
PLASTIC 4
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL FLUORIDE (1 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
W
2
3
0

FIGURE 5

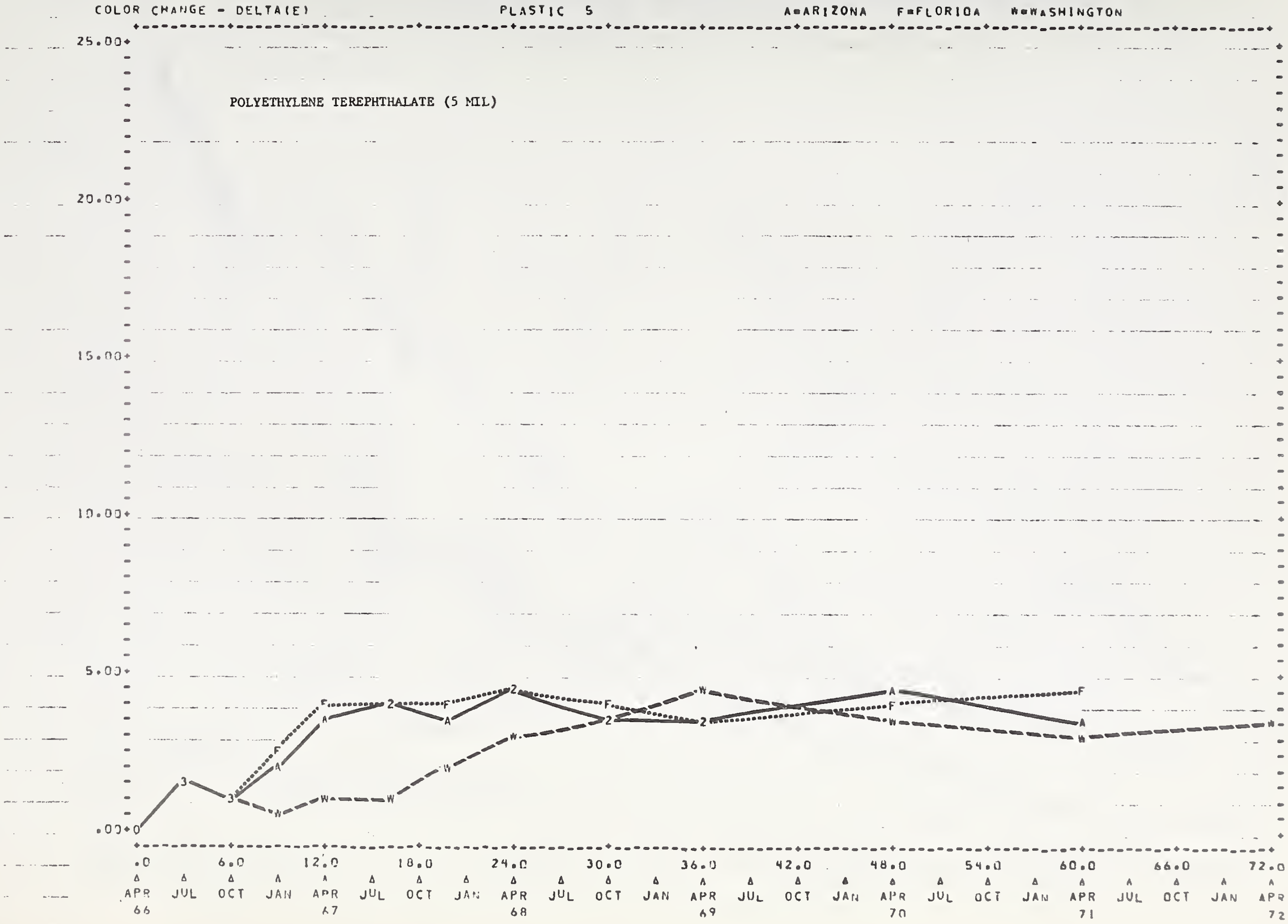

COLOR CHANGE - DELTA(E)
PLASTIC 5
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYETHYLENE TEREPHTHALATE (5 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 6

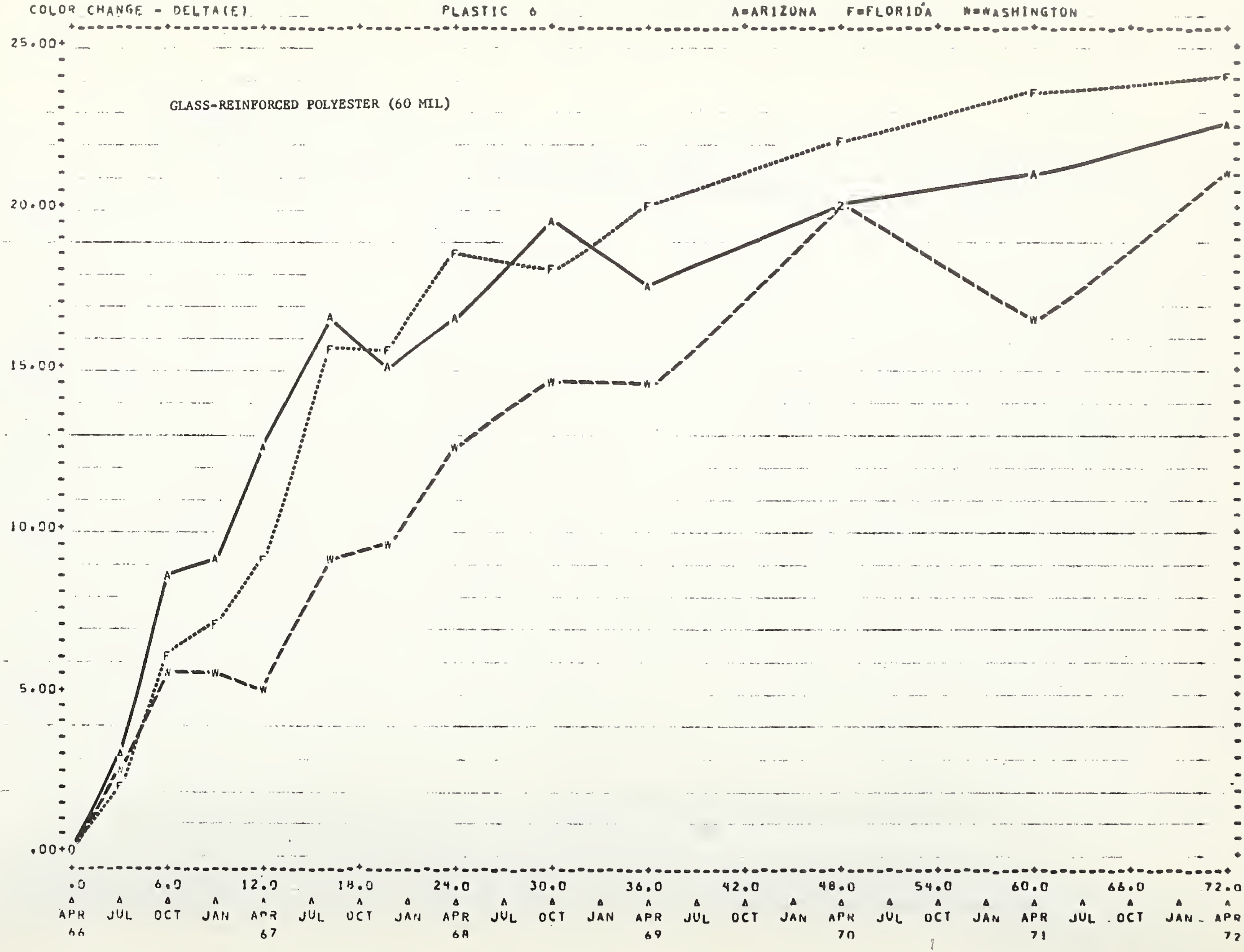
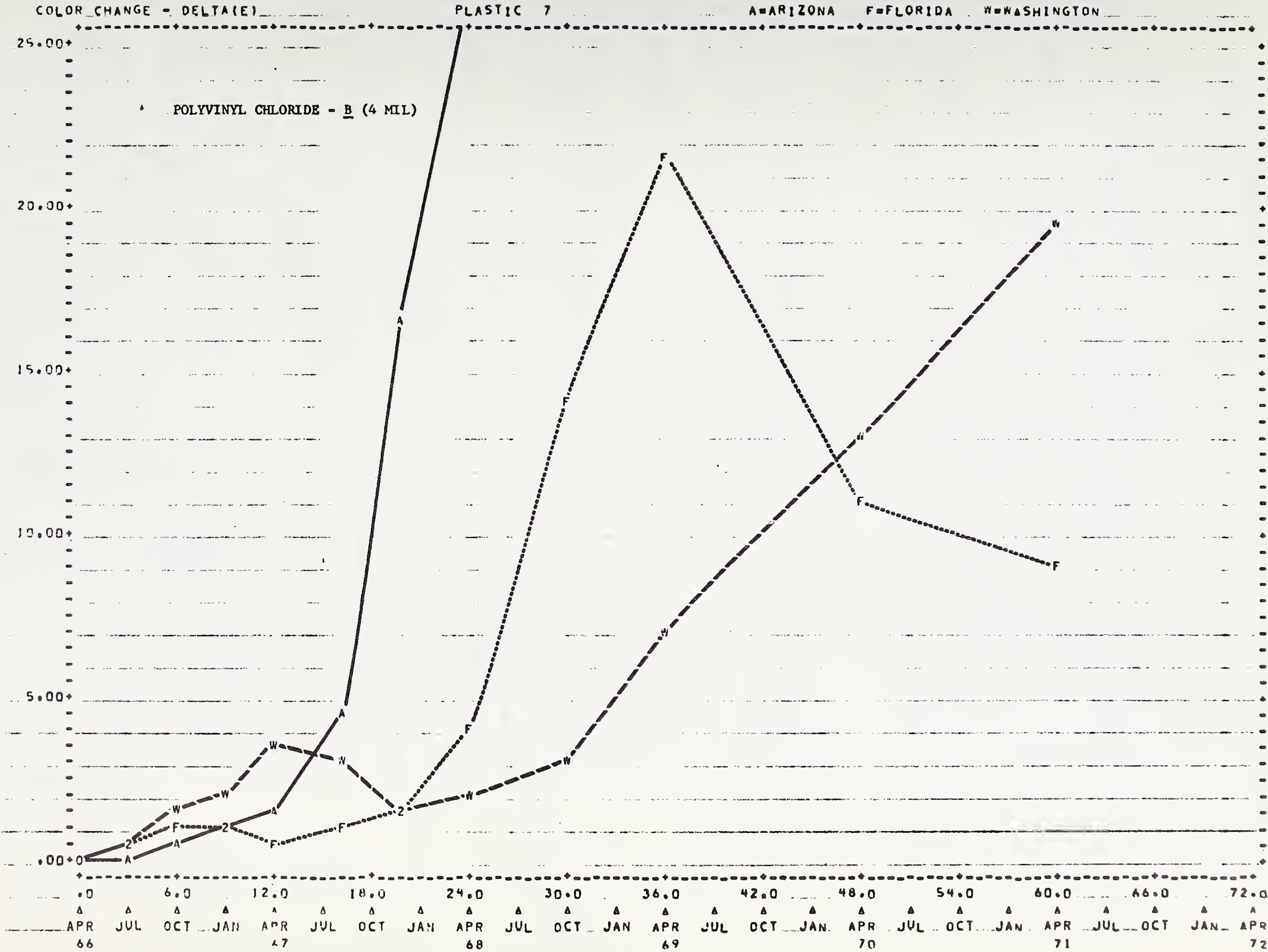
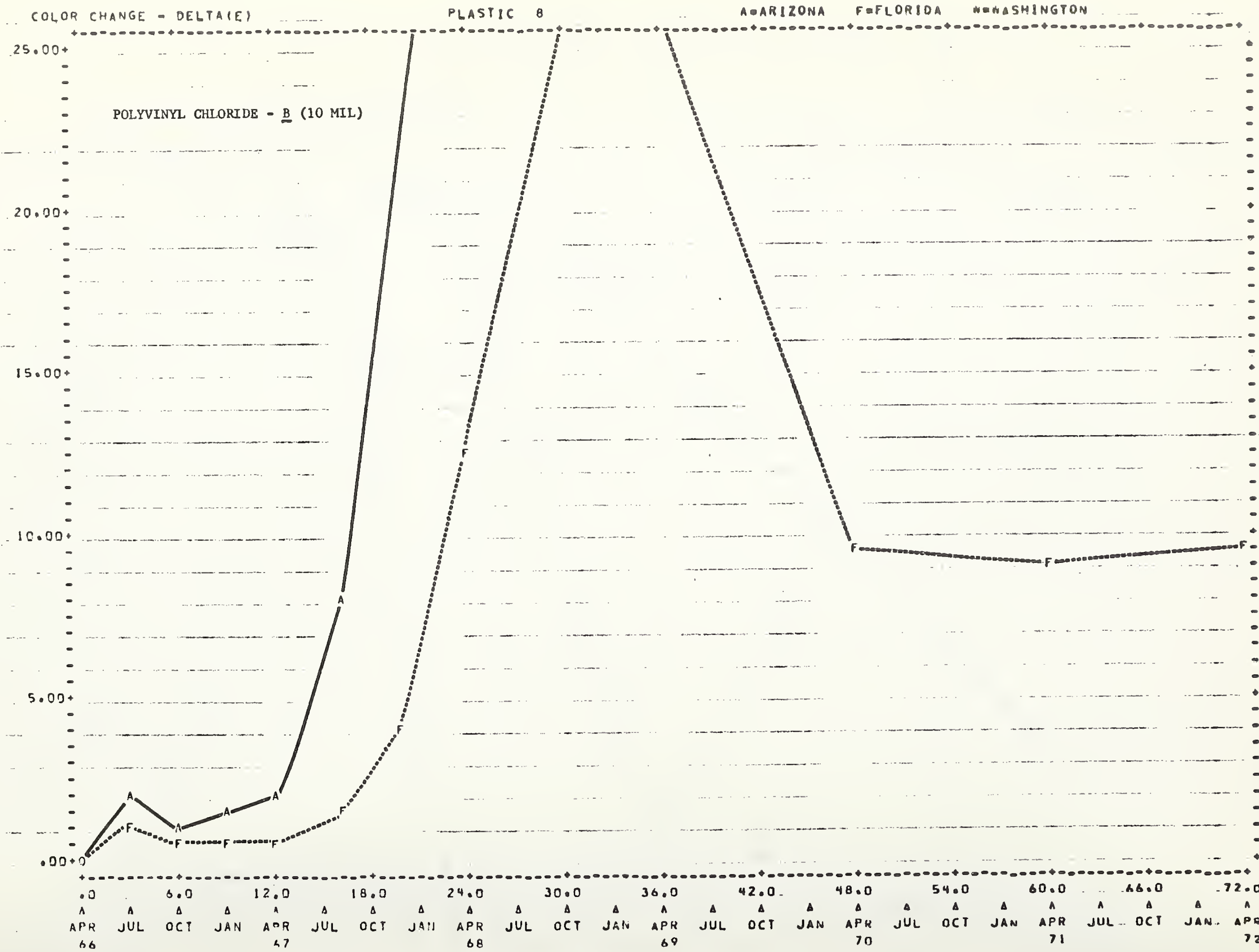

COLOR CHANGE - DELTA(E)
PLASTIC 6
A=ARIZONA
F=FLORIDA
W=WASHINGTON
GLASS-REINFORCED POLYESTER (60 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 7



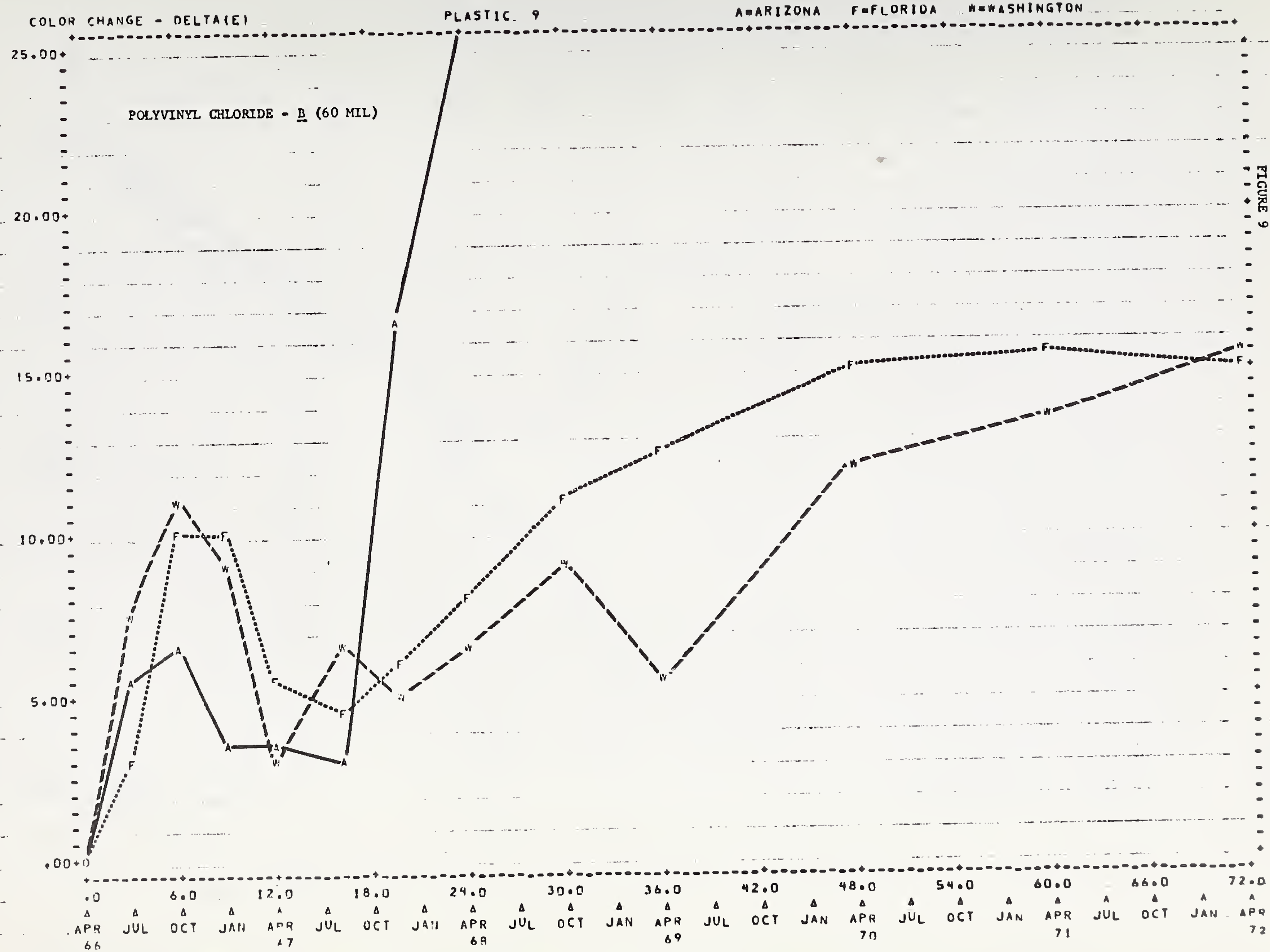
**NOTE. 2 POINTS FELL OUTSIDE THE SPECIFIED LIMITS AND WERE OMITTED.

FIGURE 8

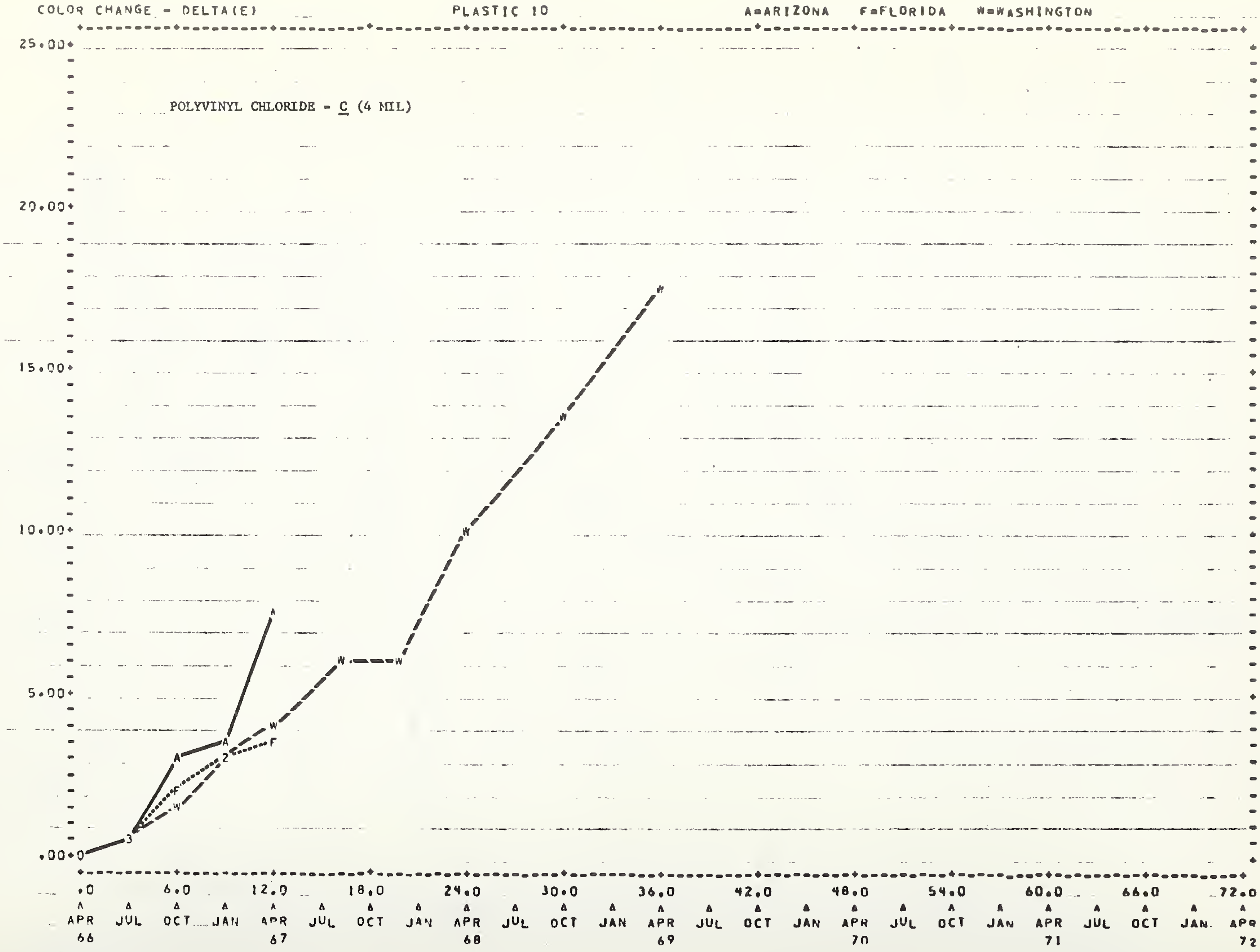


**NOTE. 6 POINTS FELL OUTSIDE THE SPECIFIED LIMITS AND WERE OMITTED.

FIGURE 9



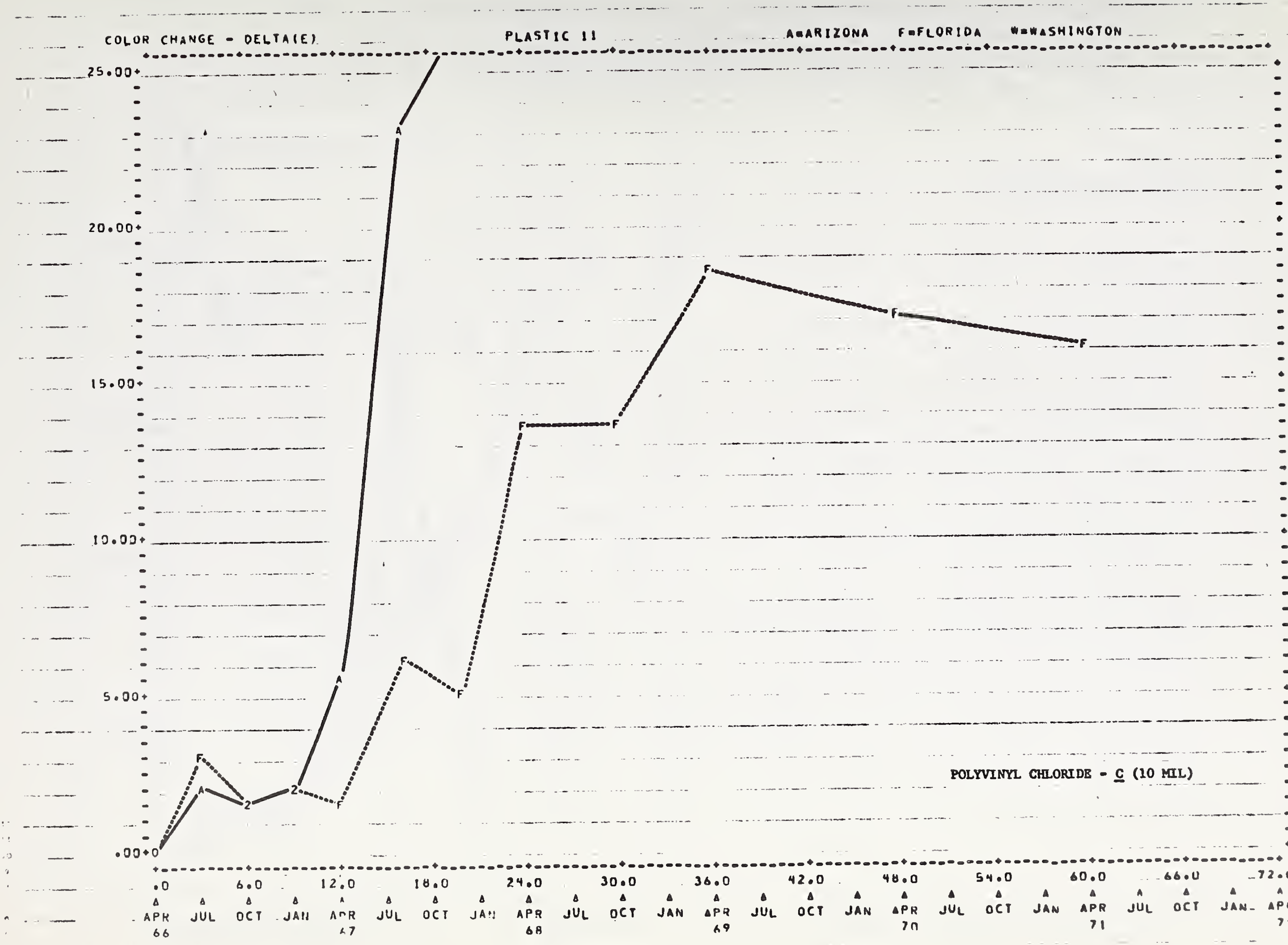
**NOTE. 5 POINTS FELL OUTSIDE THE SPECIFIED LIMITS AND WERE OMITTED.



COLOR CHANGE - DELTA(E)
PLASTIC 10
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - C (4 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
0
3
A
F
W
2

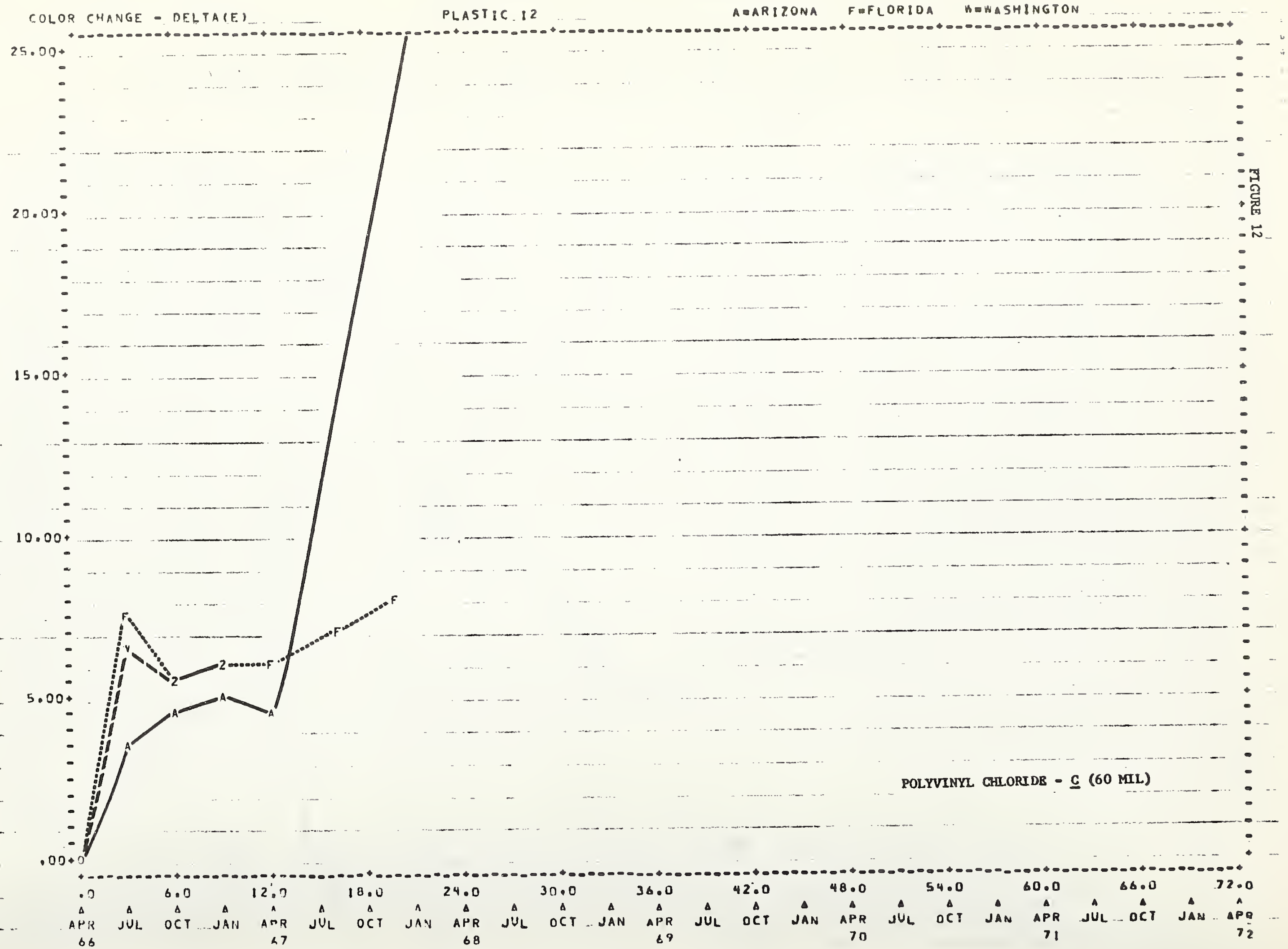
FIGURE 10

FIGURE 11



**NOTE. 4 POINTS FELL OUTSIDE THE SPECIFIED LIMITS AND WERE OMITTED.

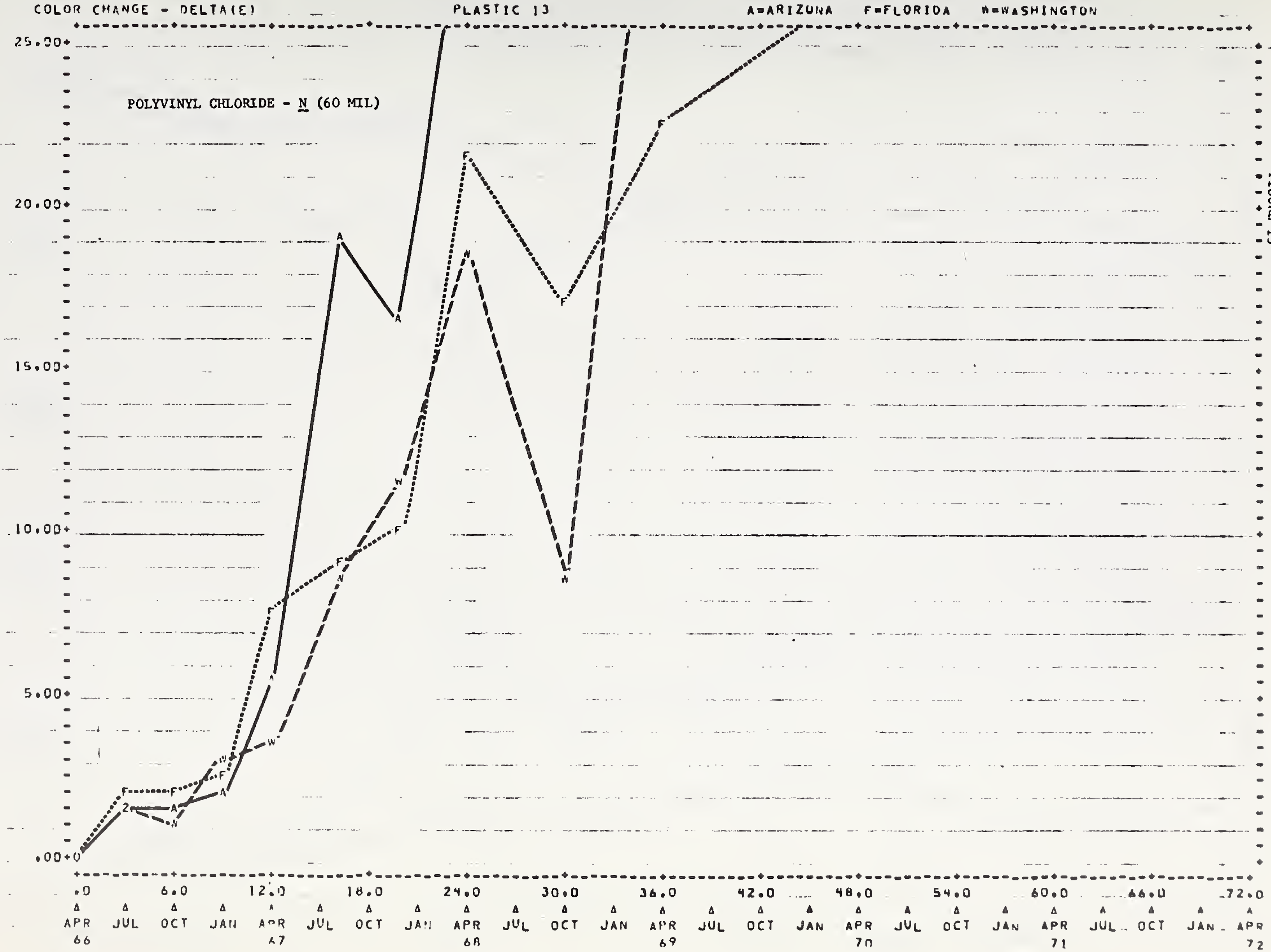
FIGURE 12



POLYVINYL CHLORIDE - C (60 MIL)

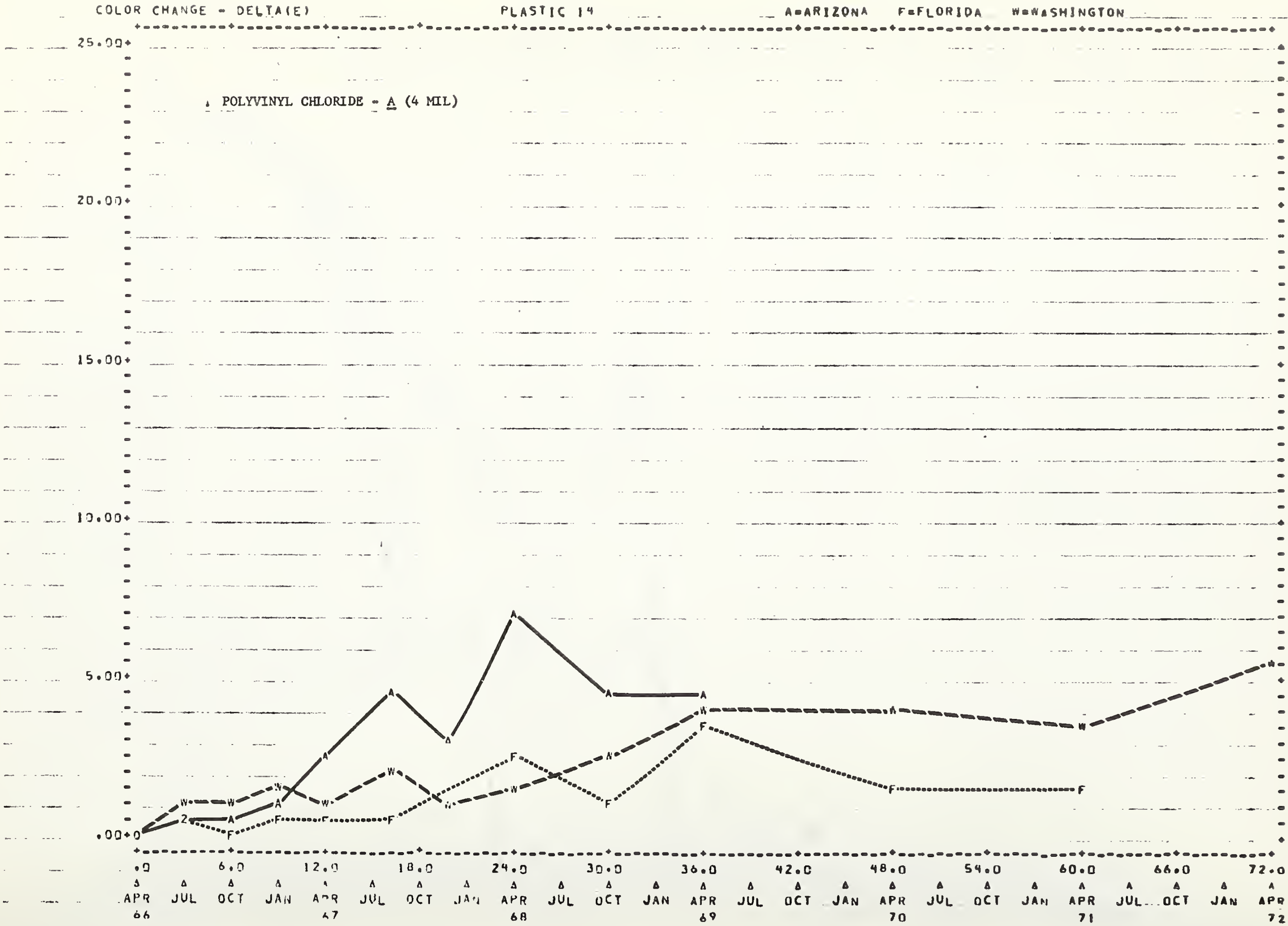
**NOTE. 1 POINTS FELL OUTSIDE THE SPECIFIED LIMITS AND WERE OMITTED.

FIGURE 13



**NOTE. 11 POINTS FELL OUTSIDE THE SPECIFIED LIMITS AND WERE OMITTED.

FIGURE 14


COLOR CHANGE - DELTA(E)
PLASTIC 14
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - A (4 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

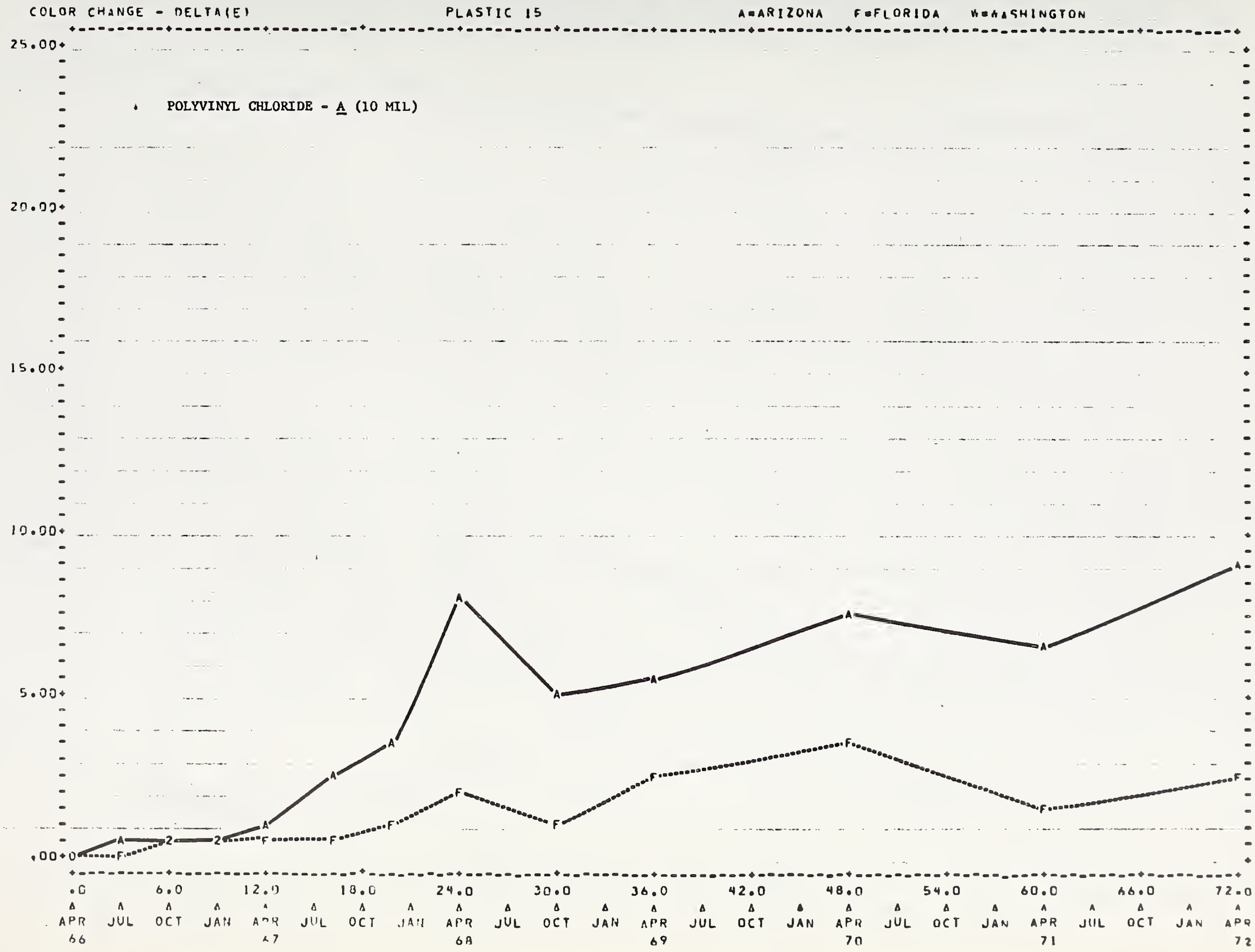

COLOR CHANGE - DELTA(E)
PLASTIC 15
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - A (10 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 15

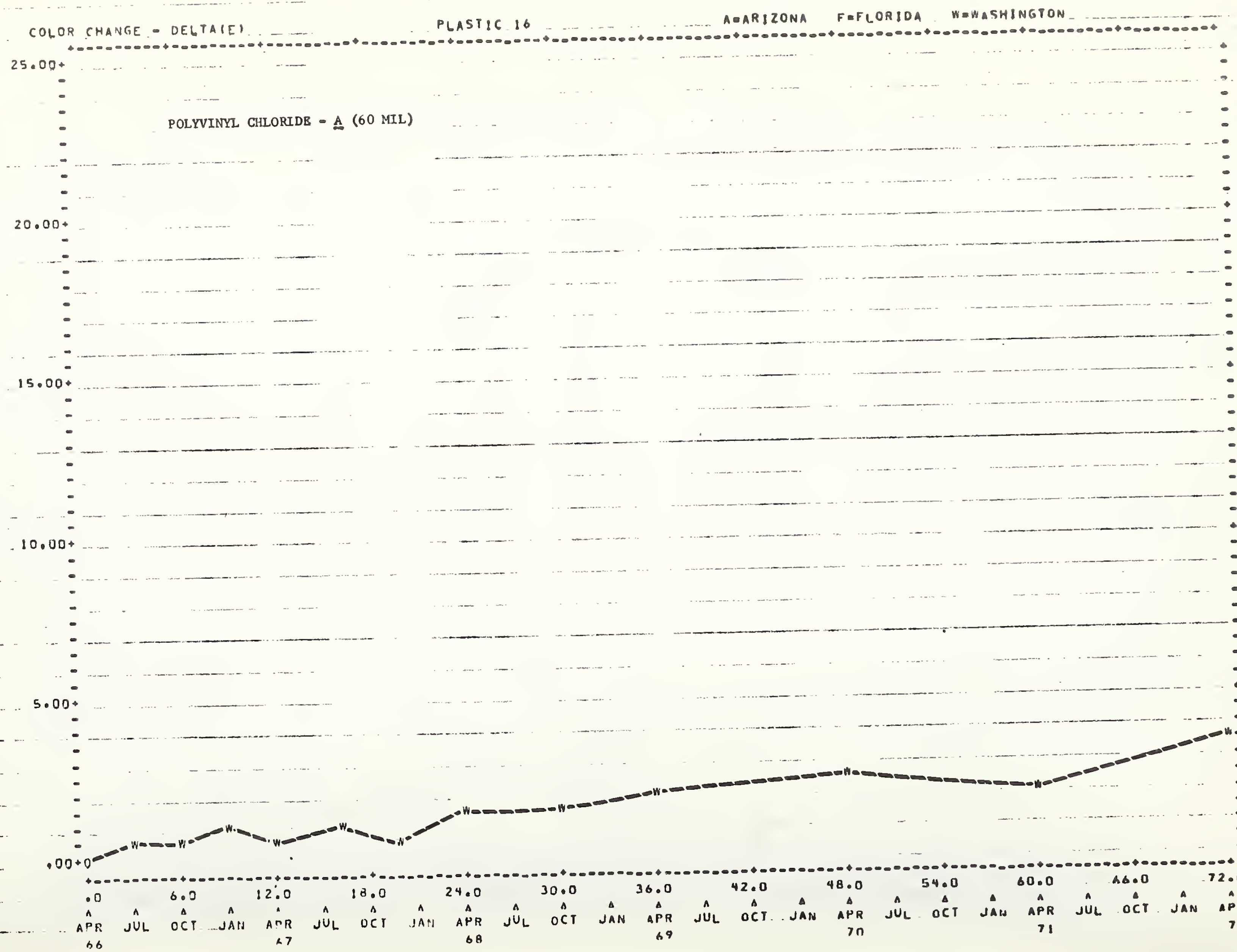

COLOR CHANGE - DELTA(E)
PLASTIC 16
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - A (60 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 16

FIGURE 17

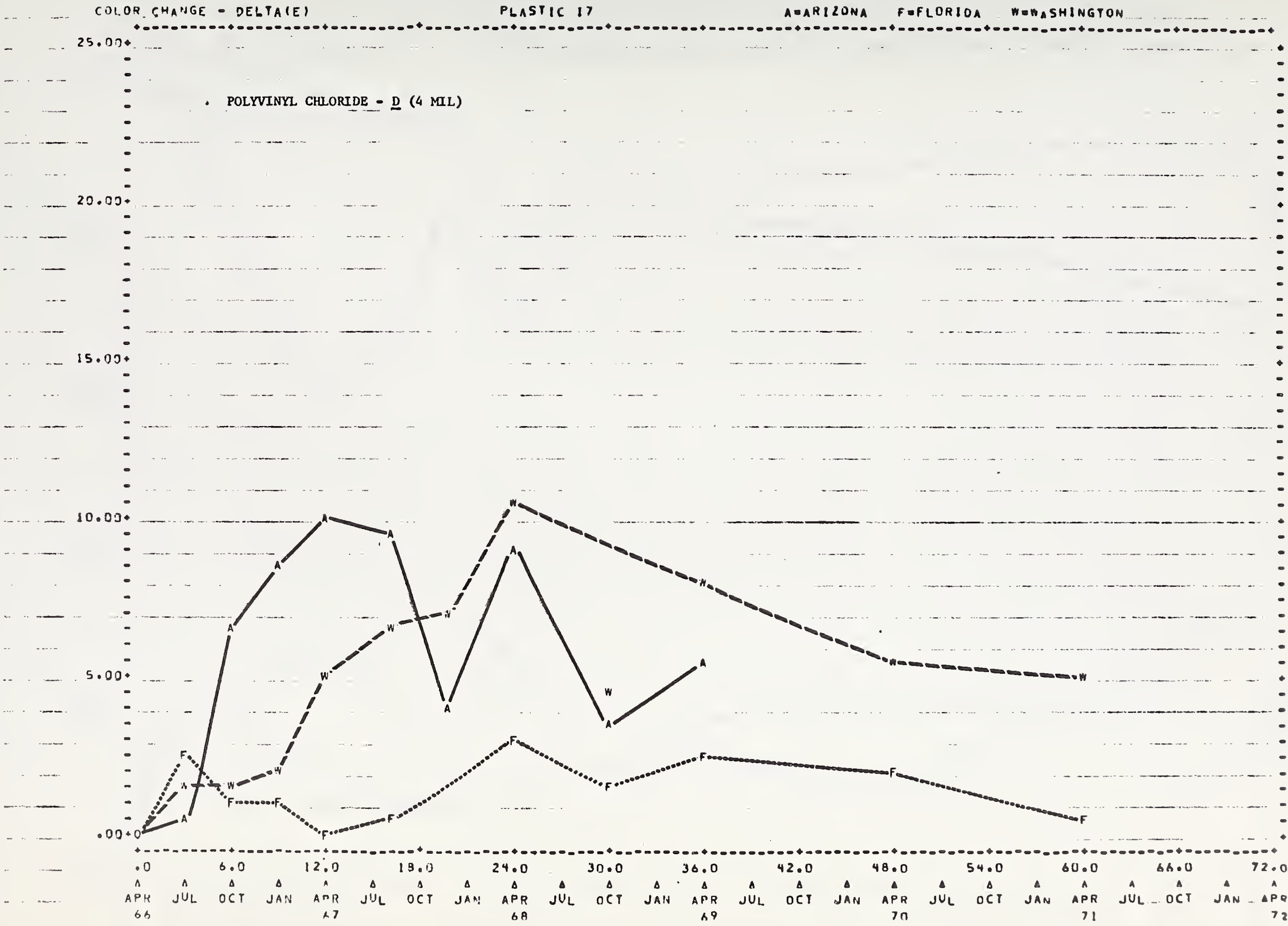

COLOR CHANGE - DELTA(E)
PLASTIC 17
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - D (4 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 18

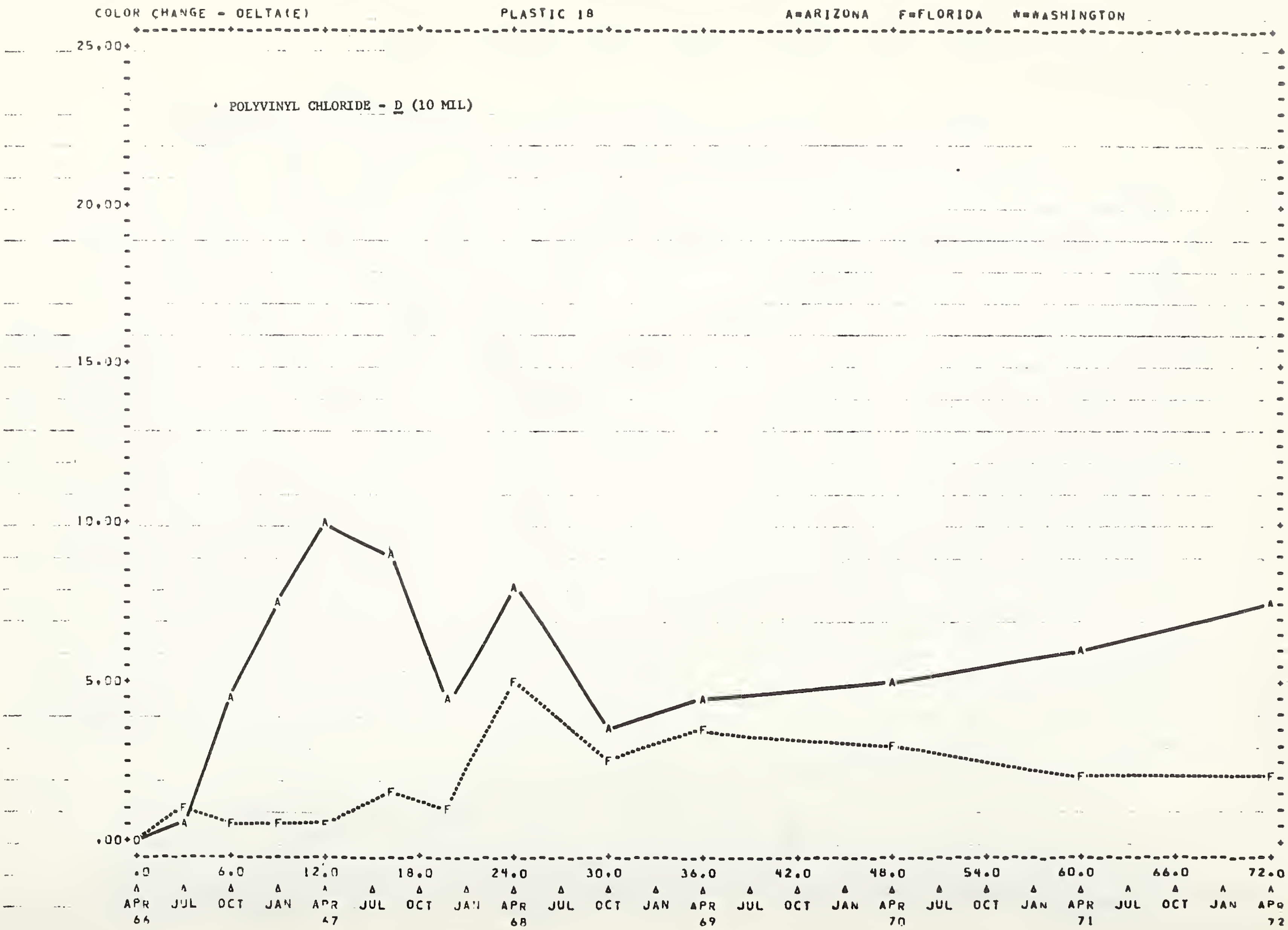

COLOR CHANGE - DELTA(E)
PLASTIC 18
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - D (10 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
0

FIGURE 19

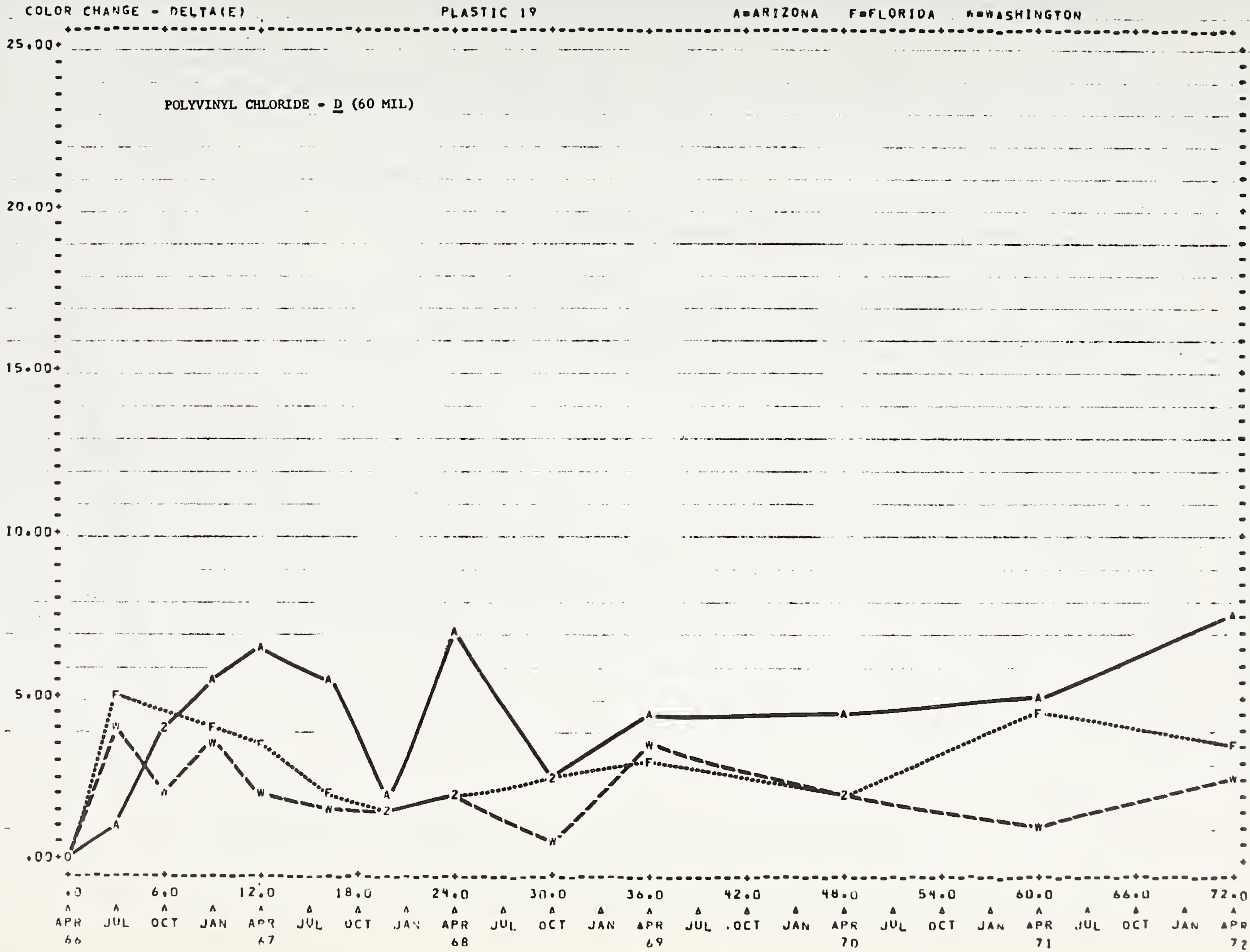

COLOR CHANGE - DELTA(E)
PLASTIC 19
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - D (60 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
W
2
0

FIGURE 20

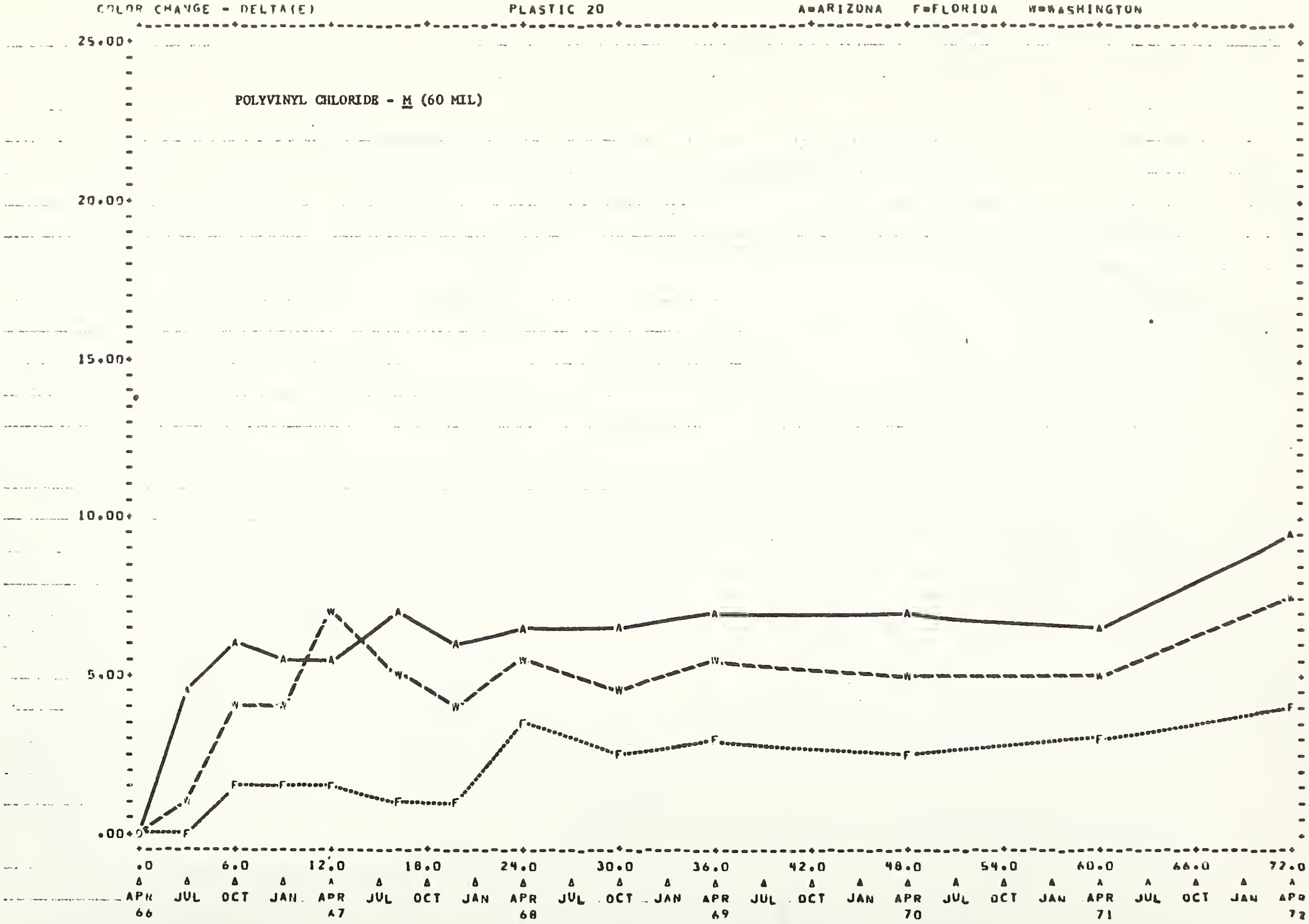

COLOR CHANGE - DELTA(E)
PLASTIC 20
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - M (60 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 21

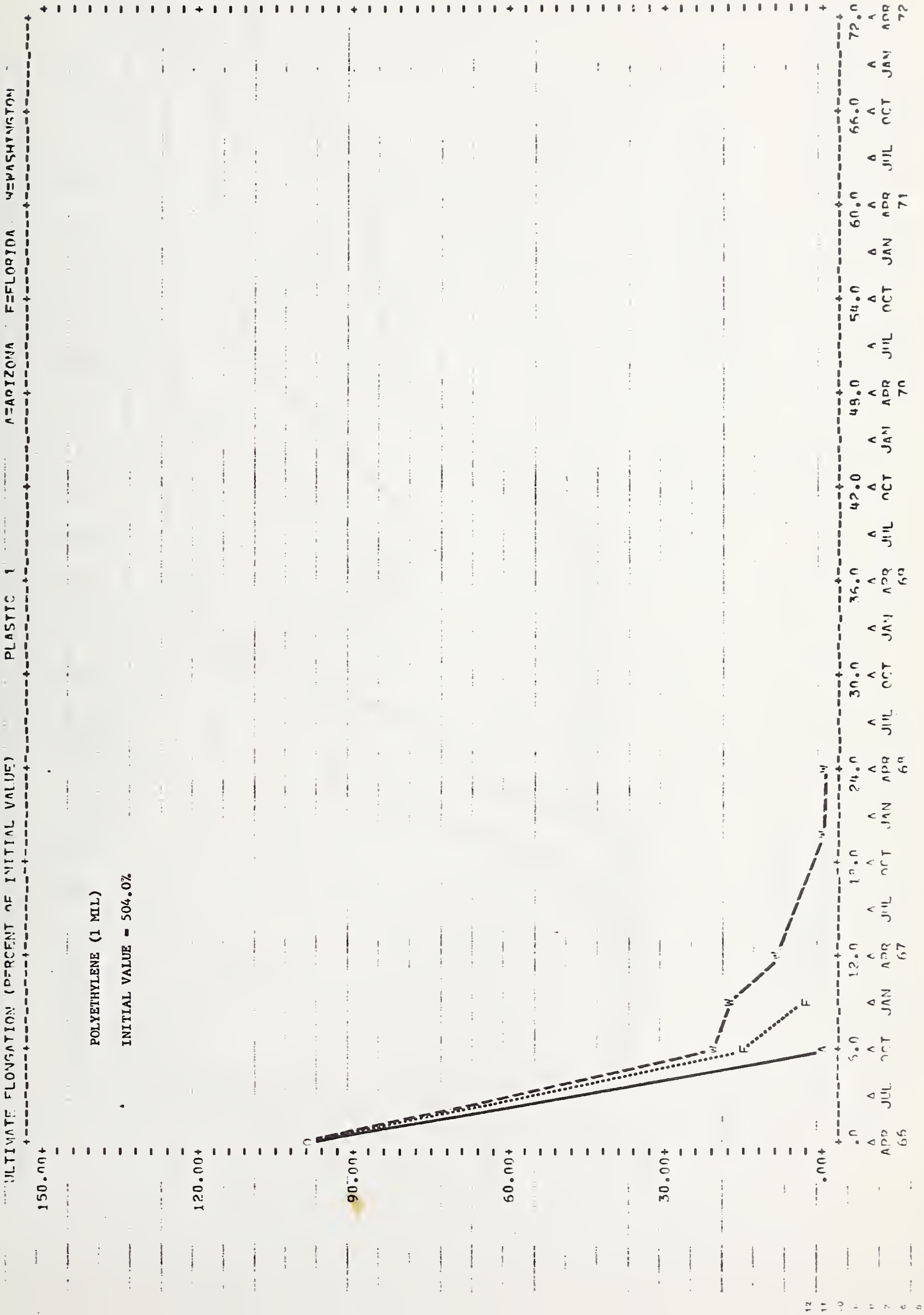

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 1
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYETHYLENE (1 MIL)
INITIAL VALUE = 504.0%
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 65
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
O
A
F
W

FIGURE 22

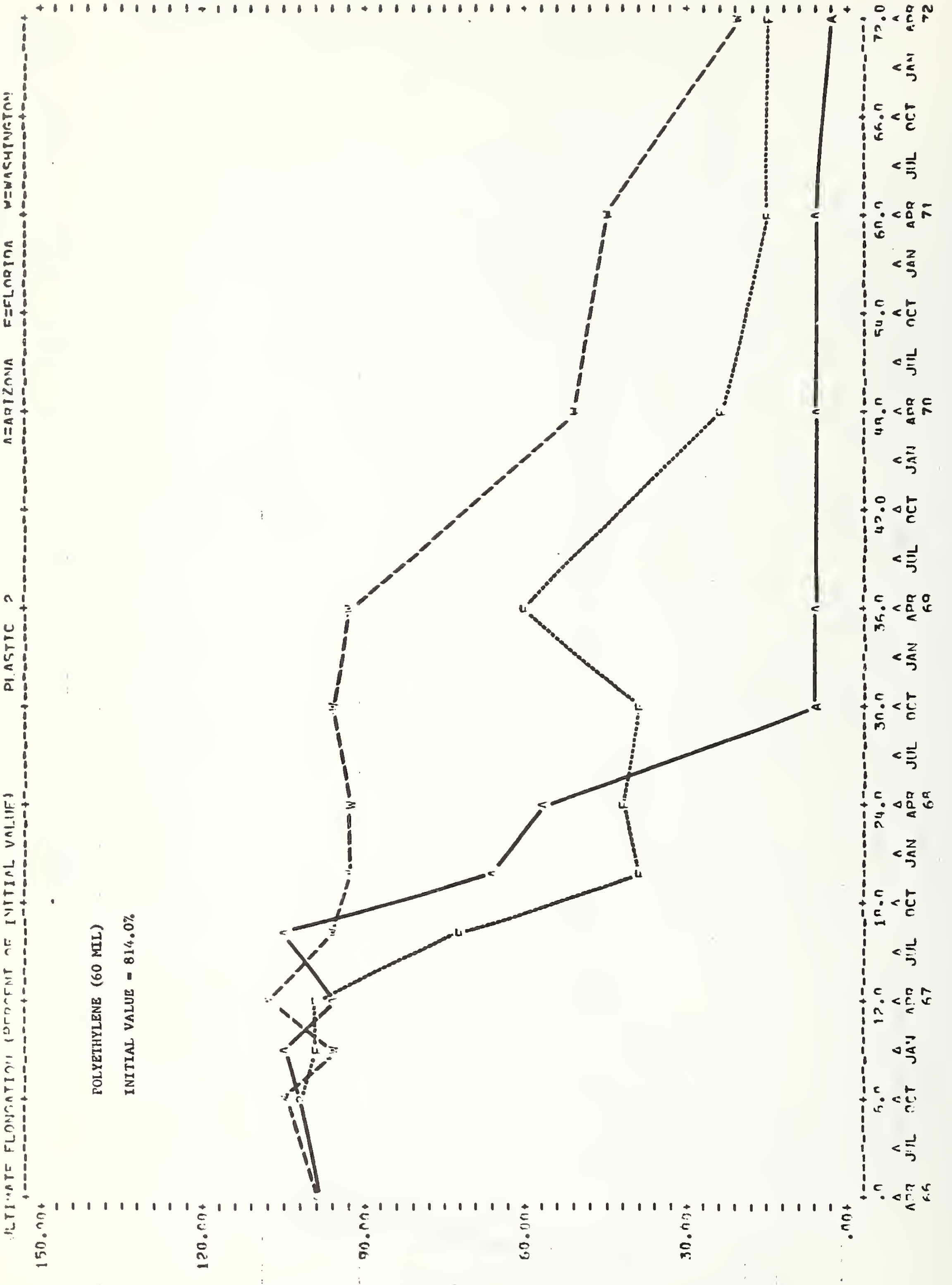
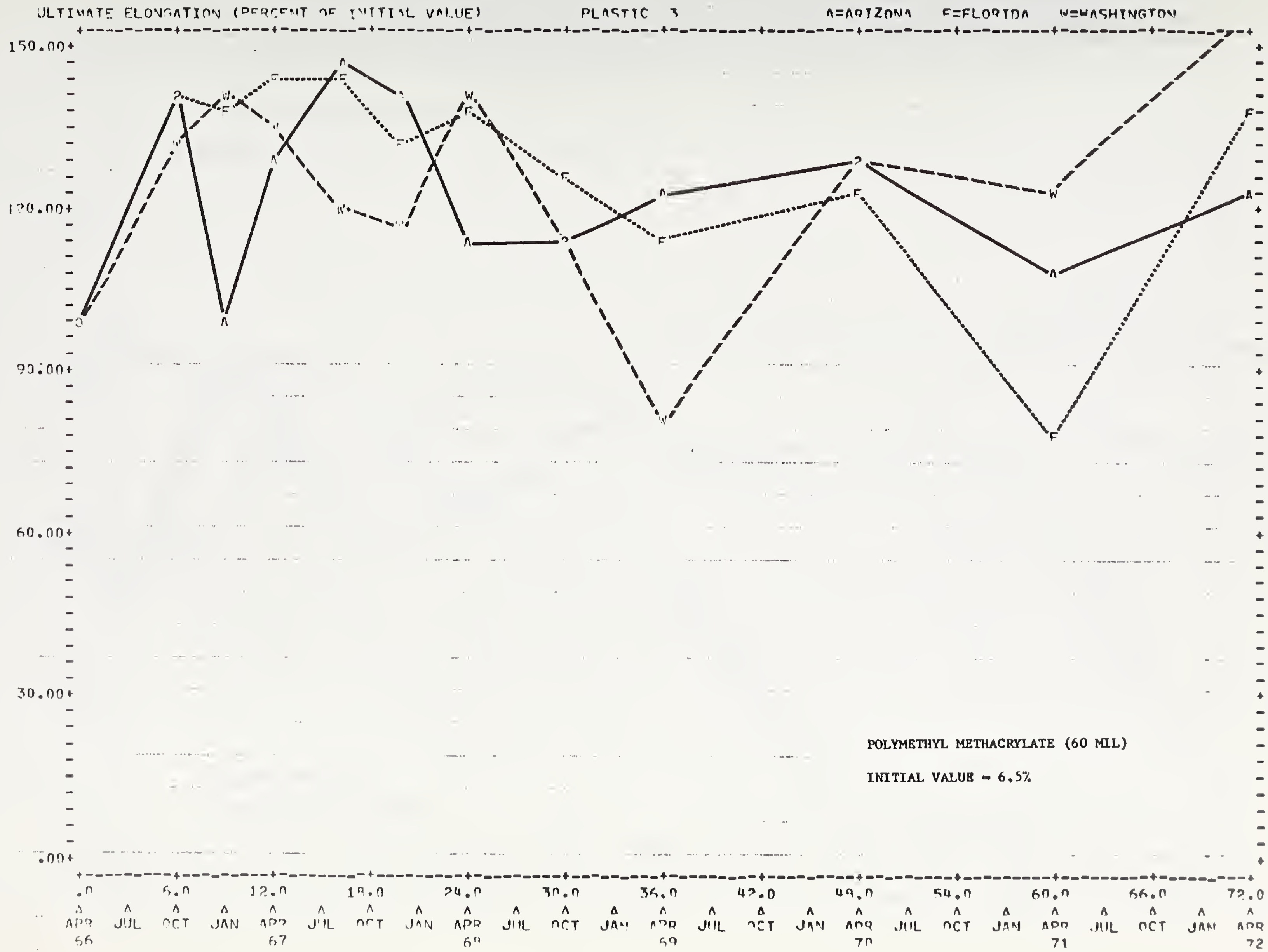

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 2
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYETHYLENE (60 MIL)
INITIAL VALUE = 814.0%
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
W

FIGURE 23



**NOTE. 1 POINTS FELL OUTSIDE THE SPECIFIED LIMITS AND WERE OMITTED.

FIGURE 24

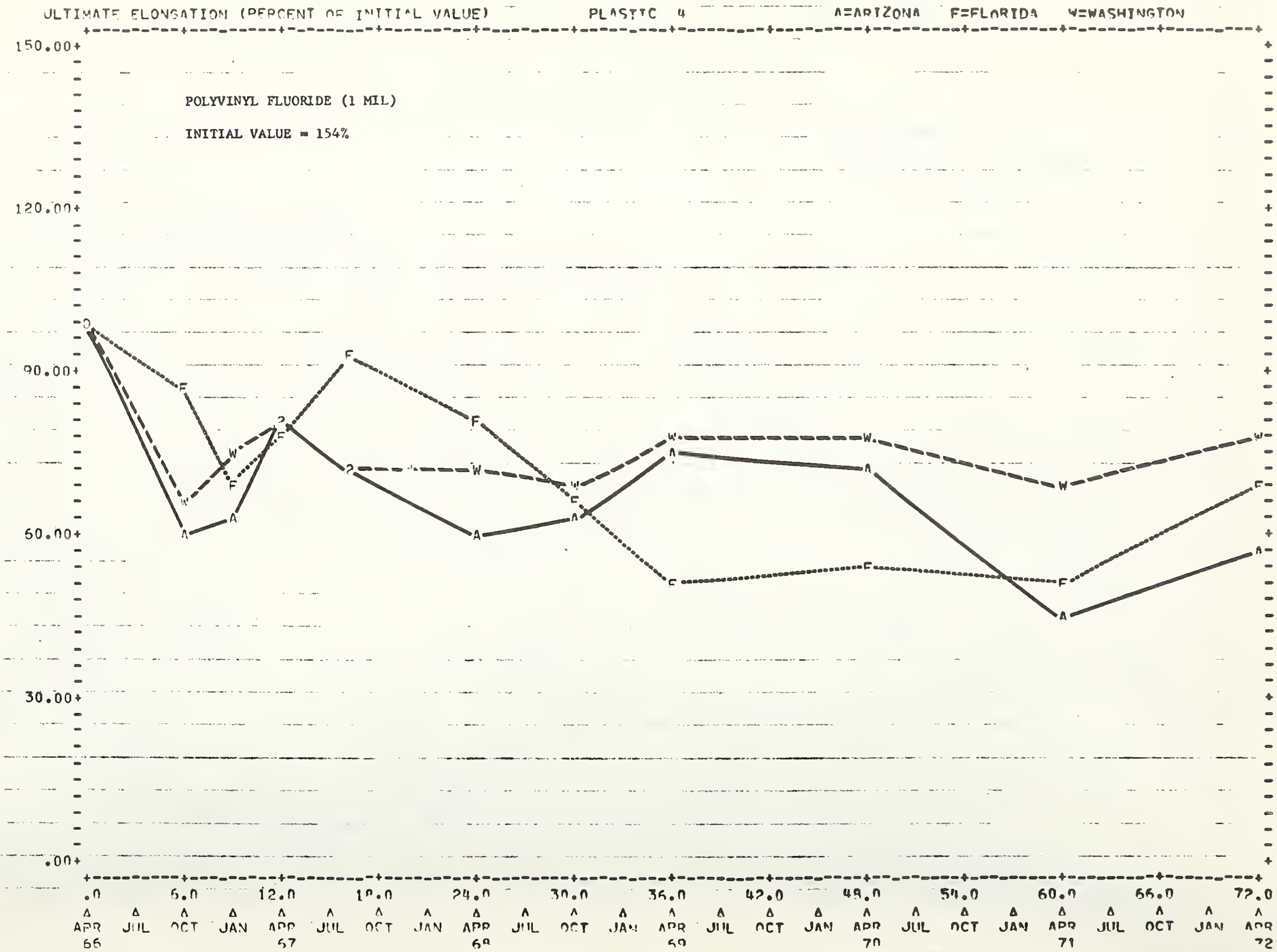

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 4
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL FLUORIDE (1 MIL)
INITIAL VALUE = 154%
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 25

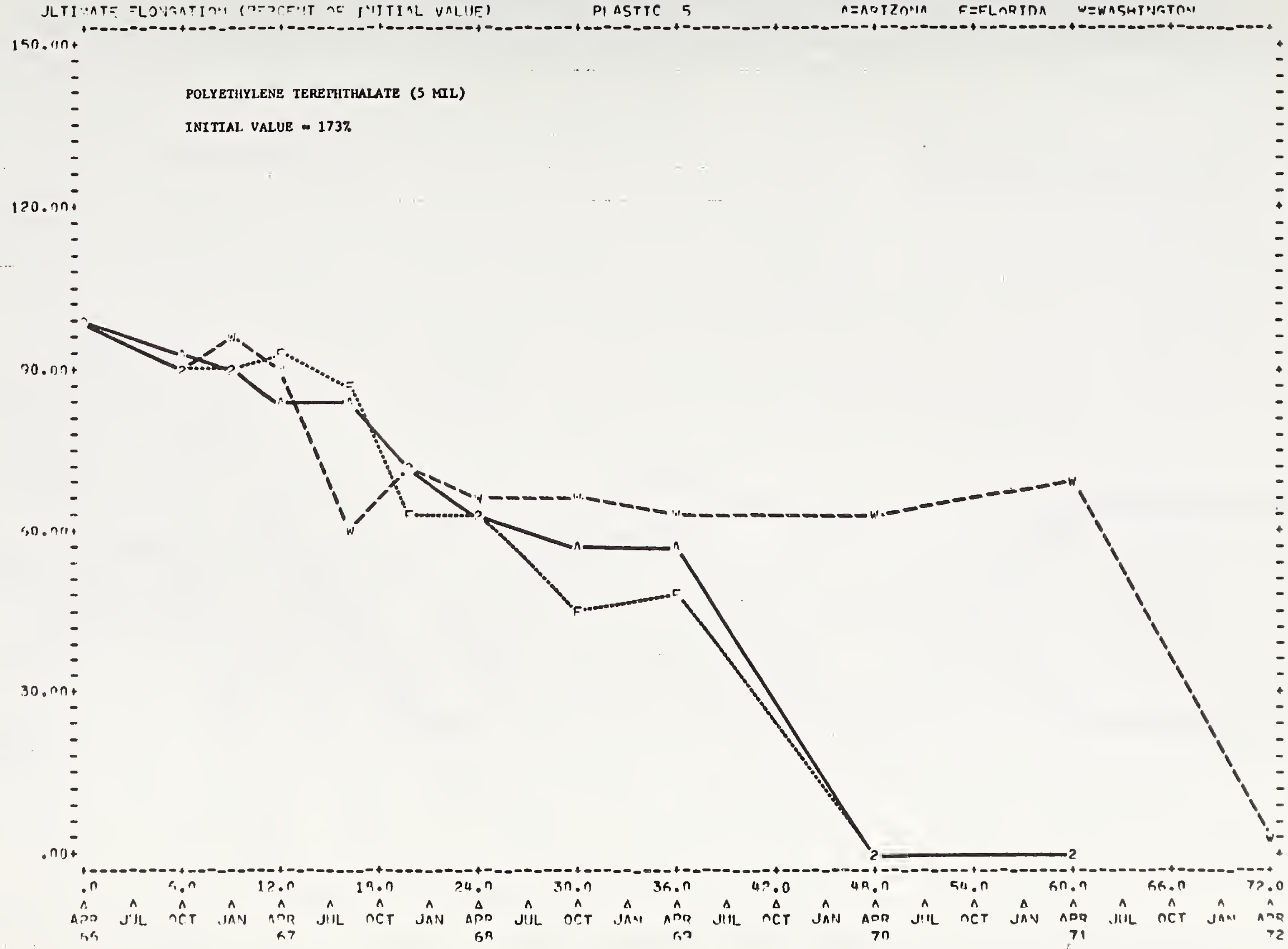

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 5
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYETHYLENE TEREPHTHALATE (5 MIL)
INITIAL VALUE = 173%
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 26

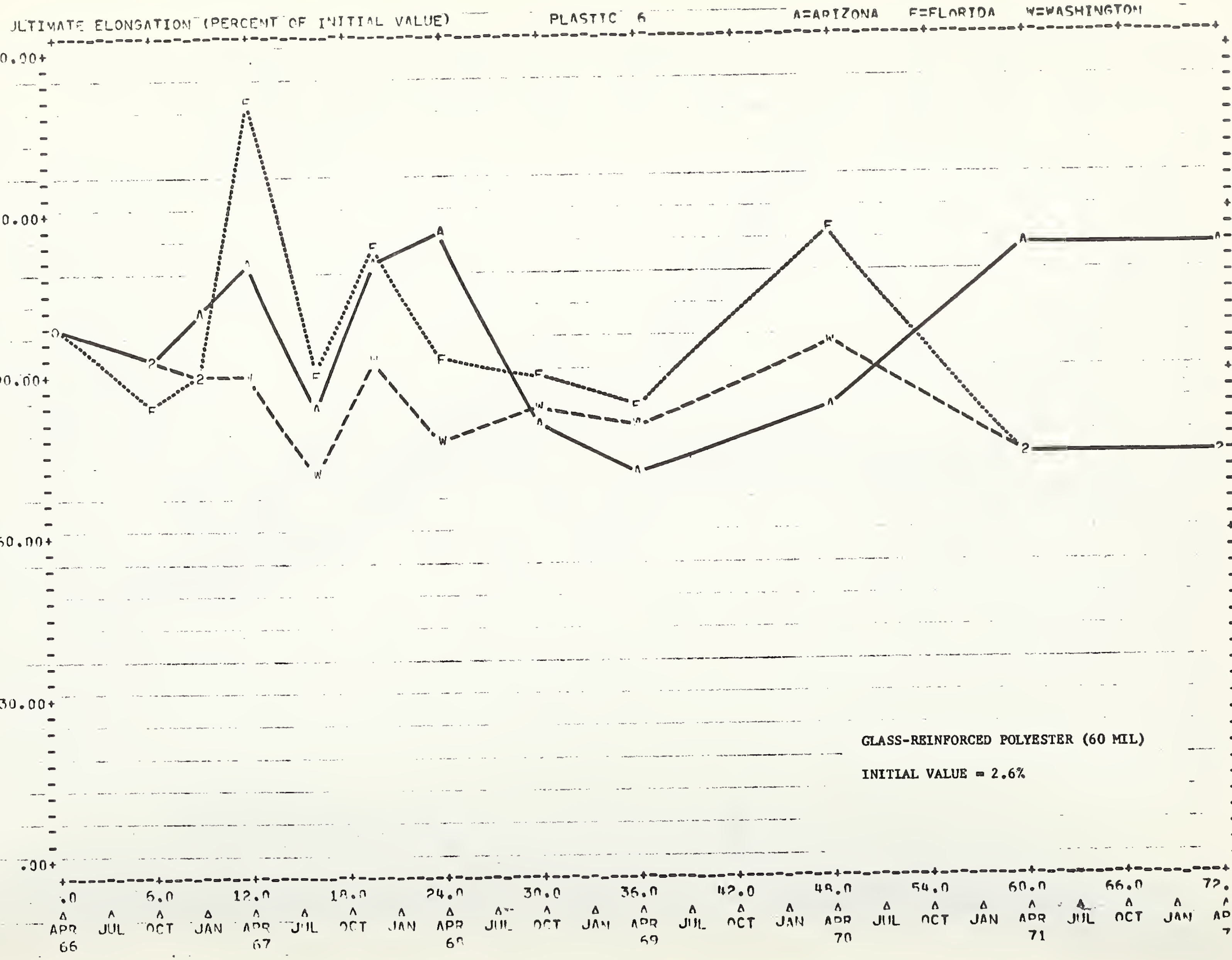

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 6
A=ARIZONA F=FLORIDA W=WASHINGTON
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
GLASS-REINFORCED POLYESTER (60 MIL)
INITIAL VALUE = 2.6%

FIGURE 27

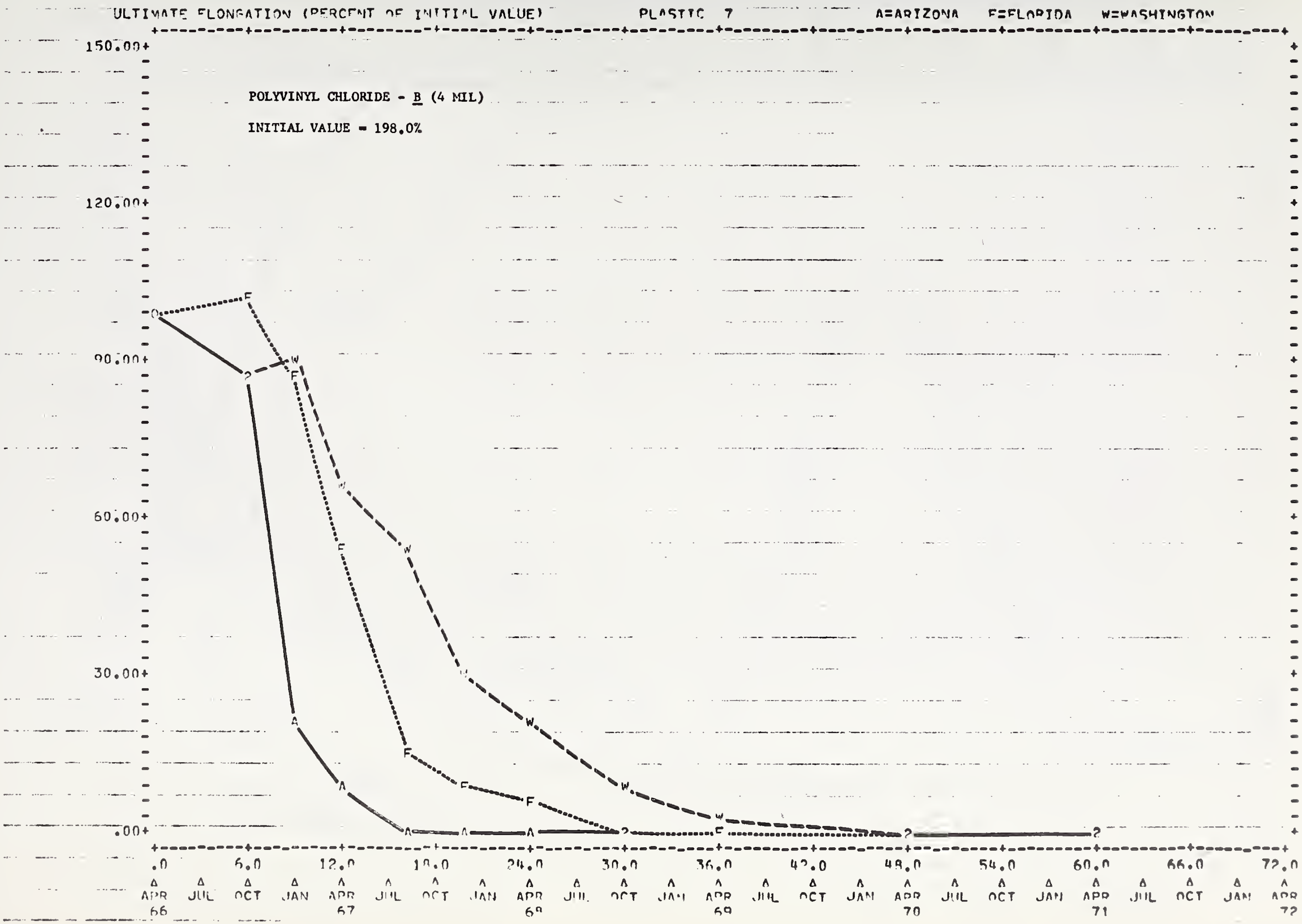

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 7
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - B (4 MIL)
INITIAL VALUE = 198.0%
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 28

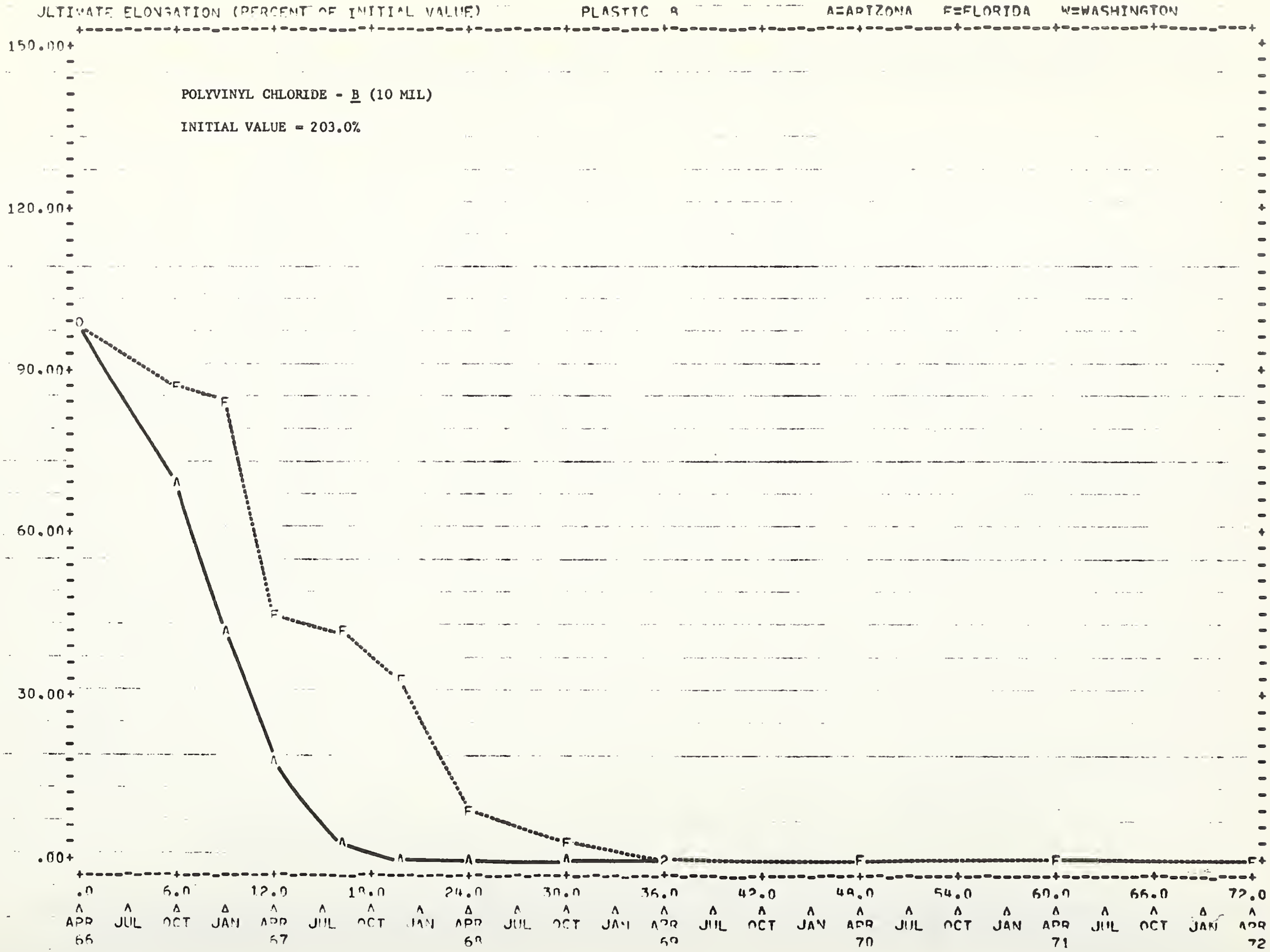

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC B
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - B (10 MIL)
INITIAL VALUE = 203.0%
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 29

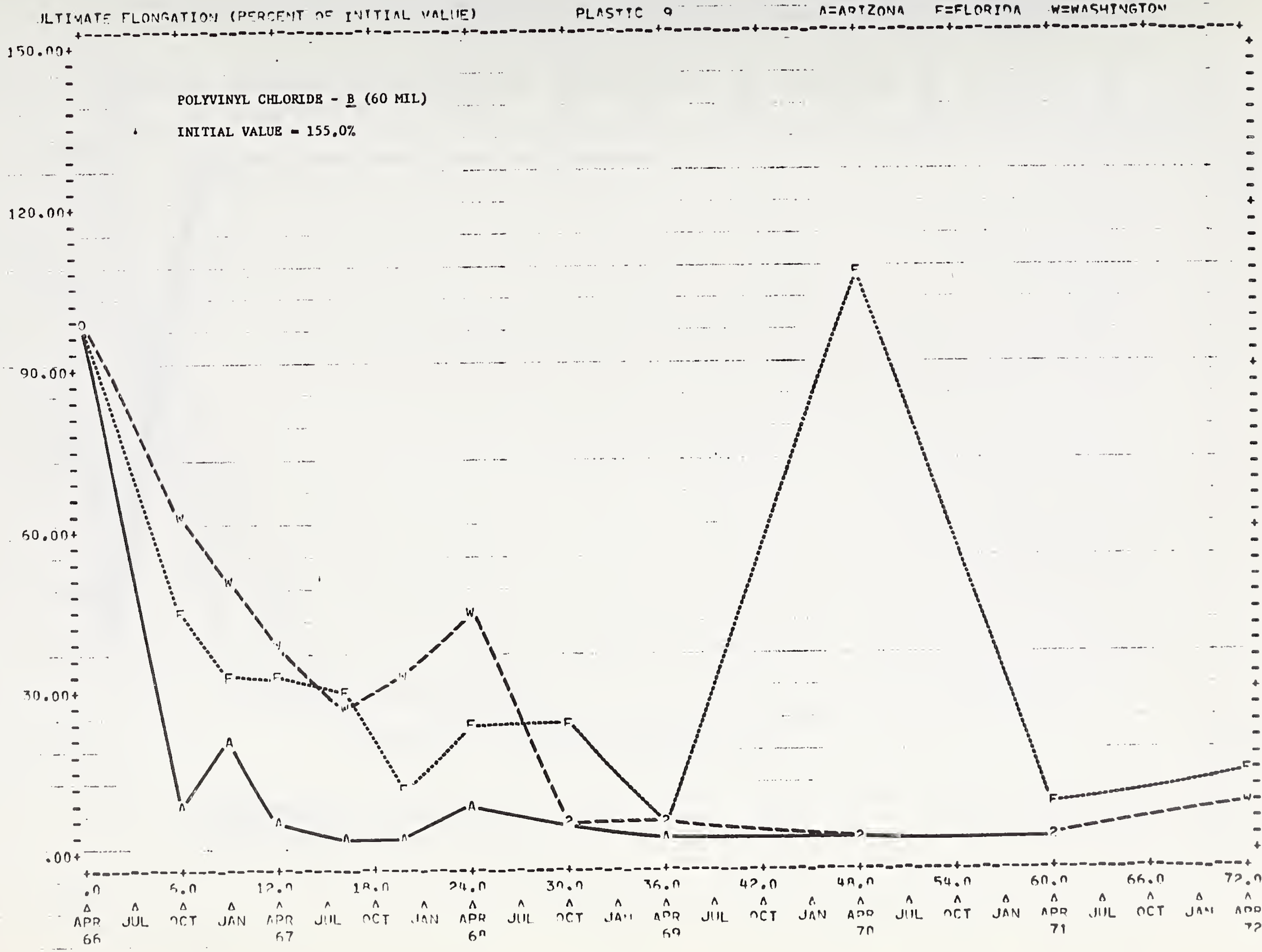
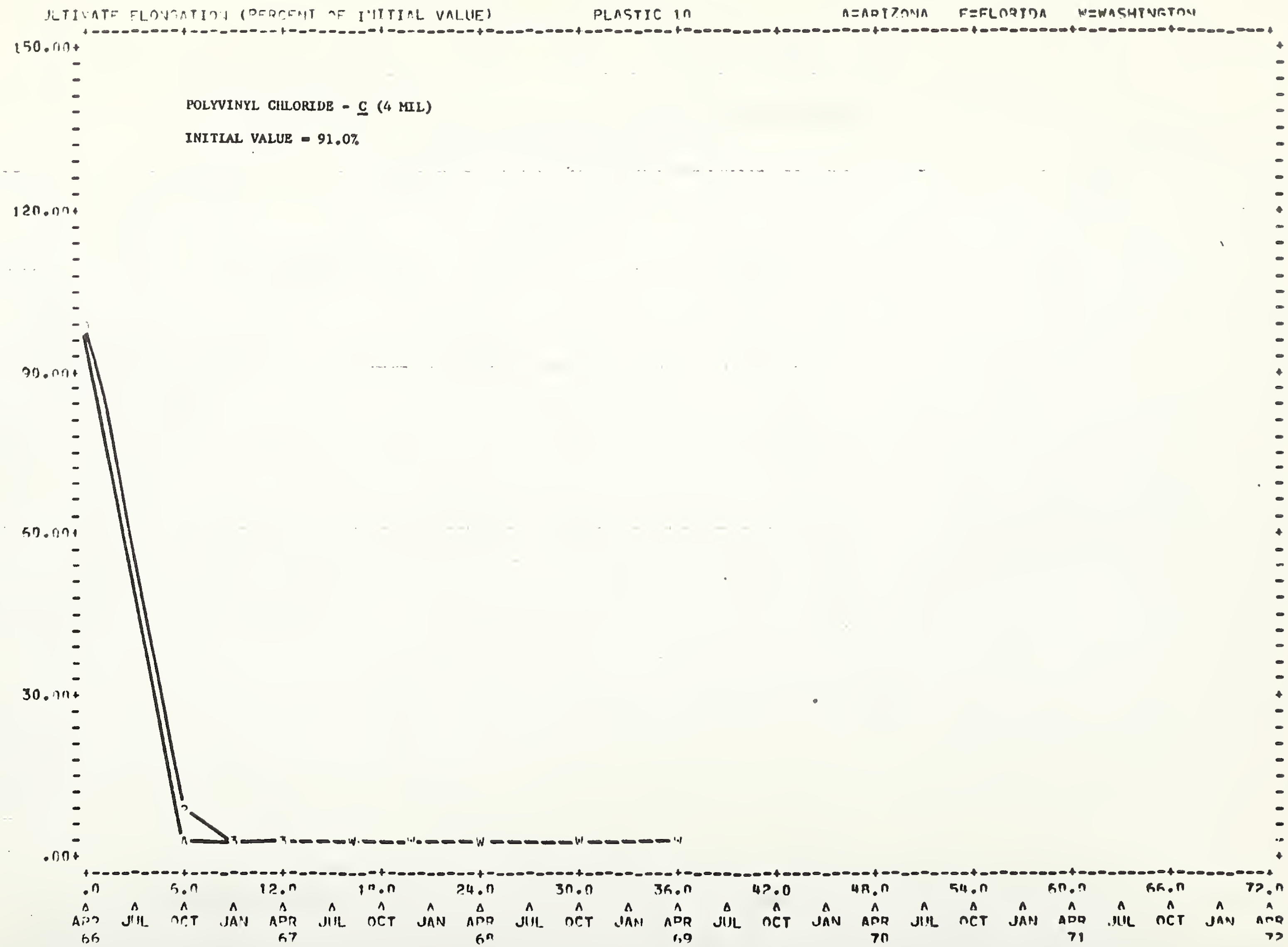

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 9
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - B (60 MIL)
INITIAL VALUE = 155.0%
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 30


ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 10
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - C (4 MIL)
INITIAL VALUE = 91.0%
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
W

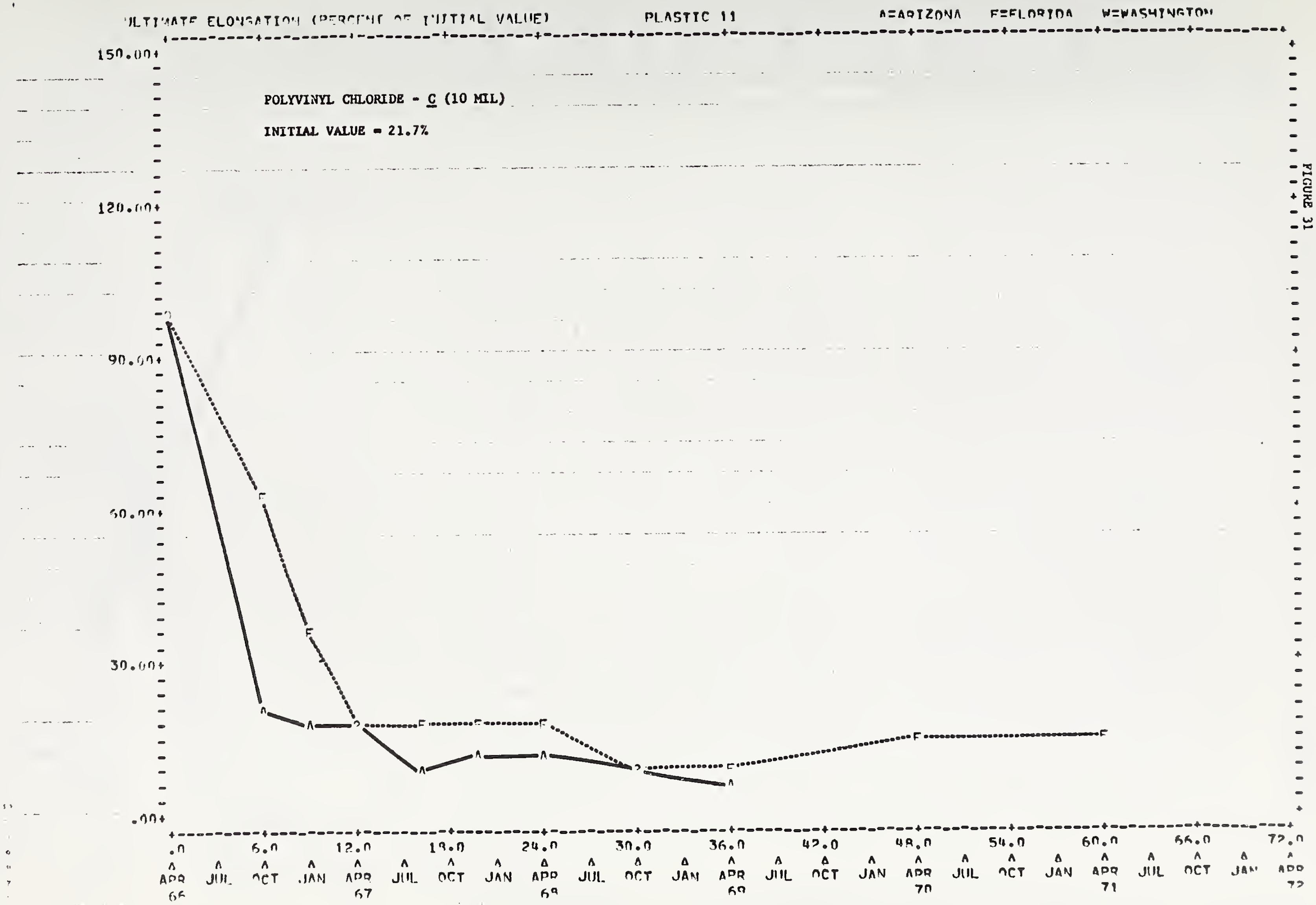

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 11
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - C (10 MIL)
INITIAL VALUE = 21.7%
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 31

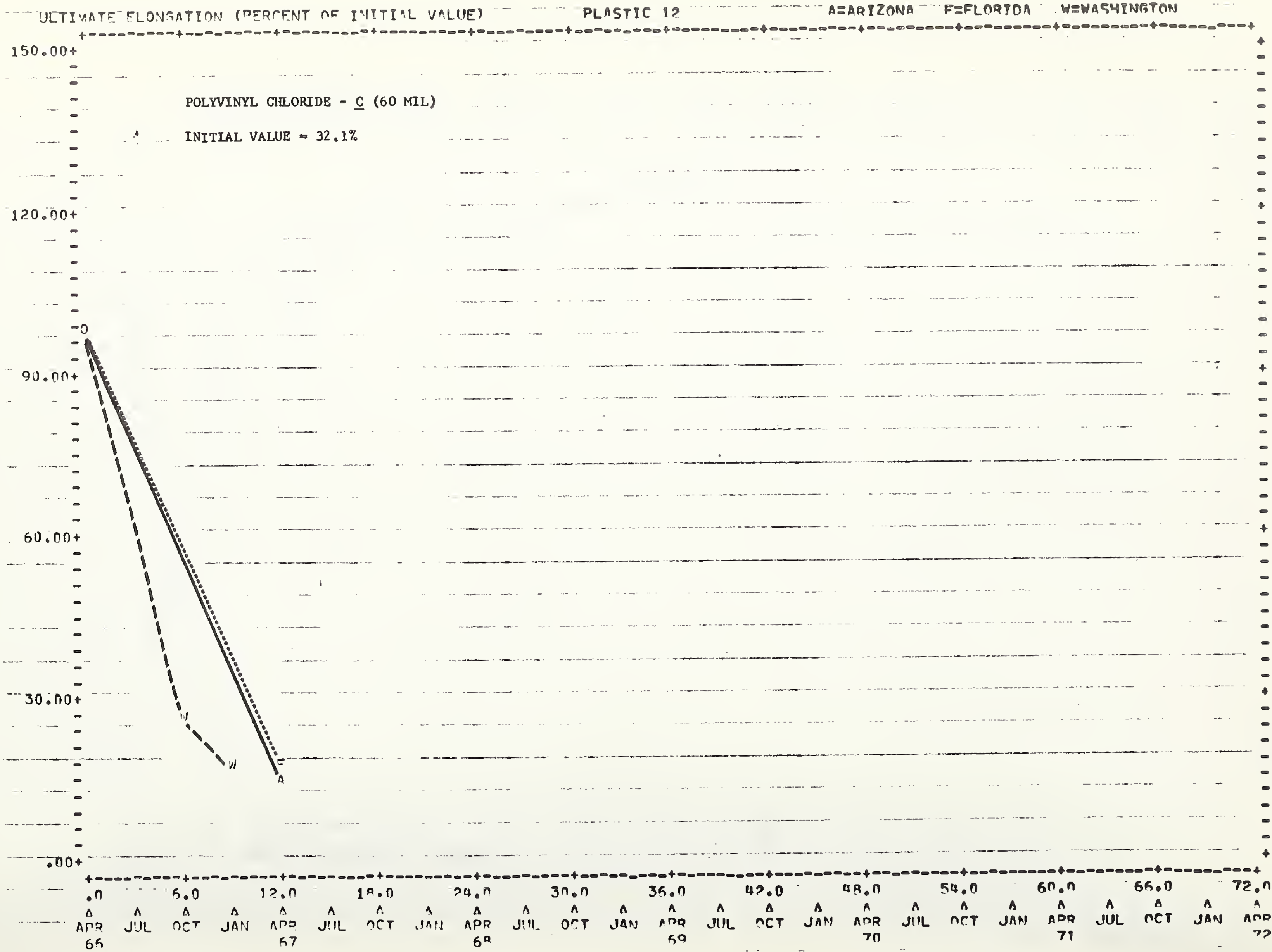


FIGURE 32

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE) PLASTIC 12 A=ARIZONA F=FLORIDA W=WASHINGTON

POLYVINYL CHLORIDE - C (60 MIL)

INITIAL VALUE = 32.1%

FIGURE 33

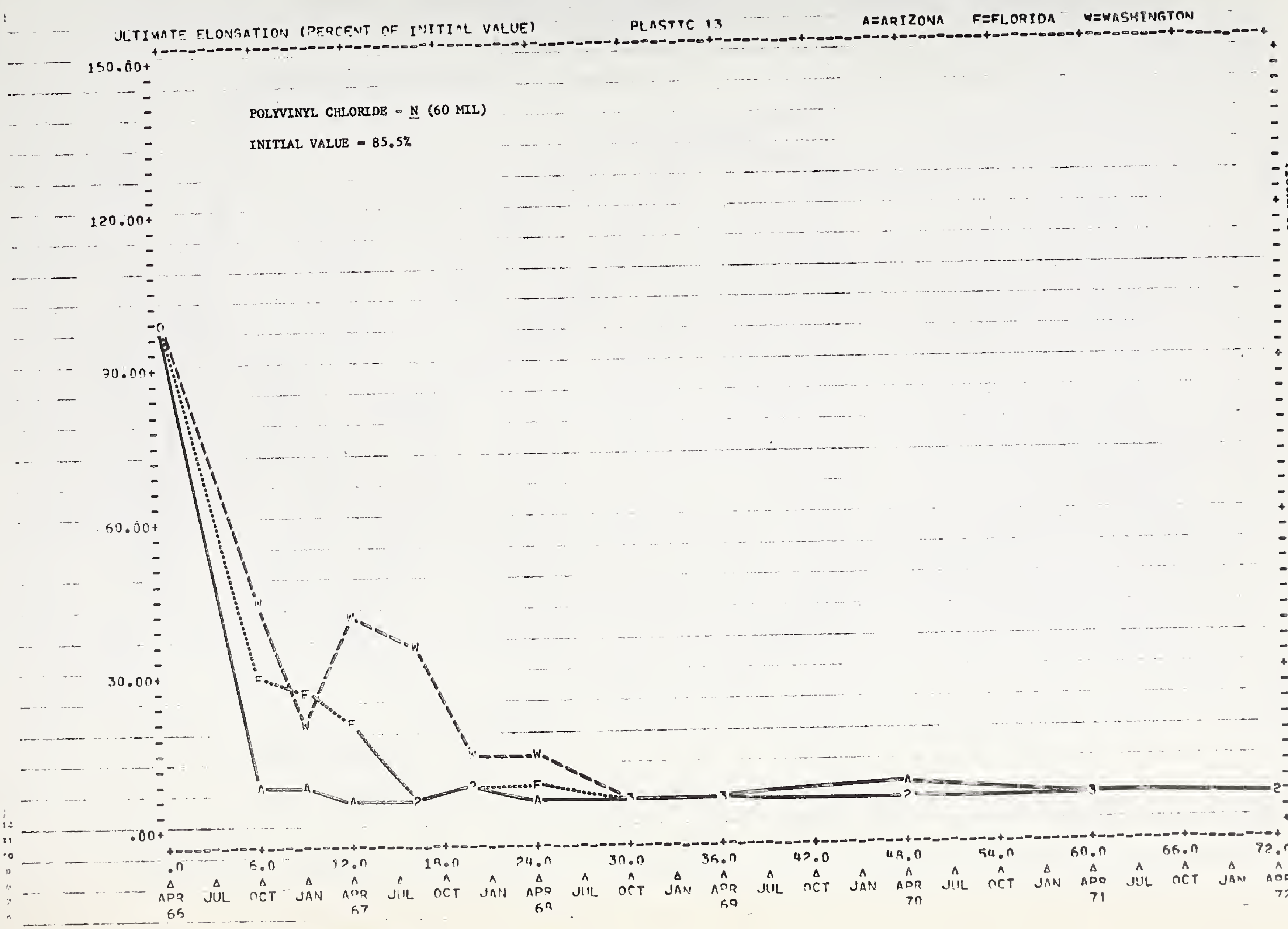
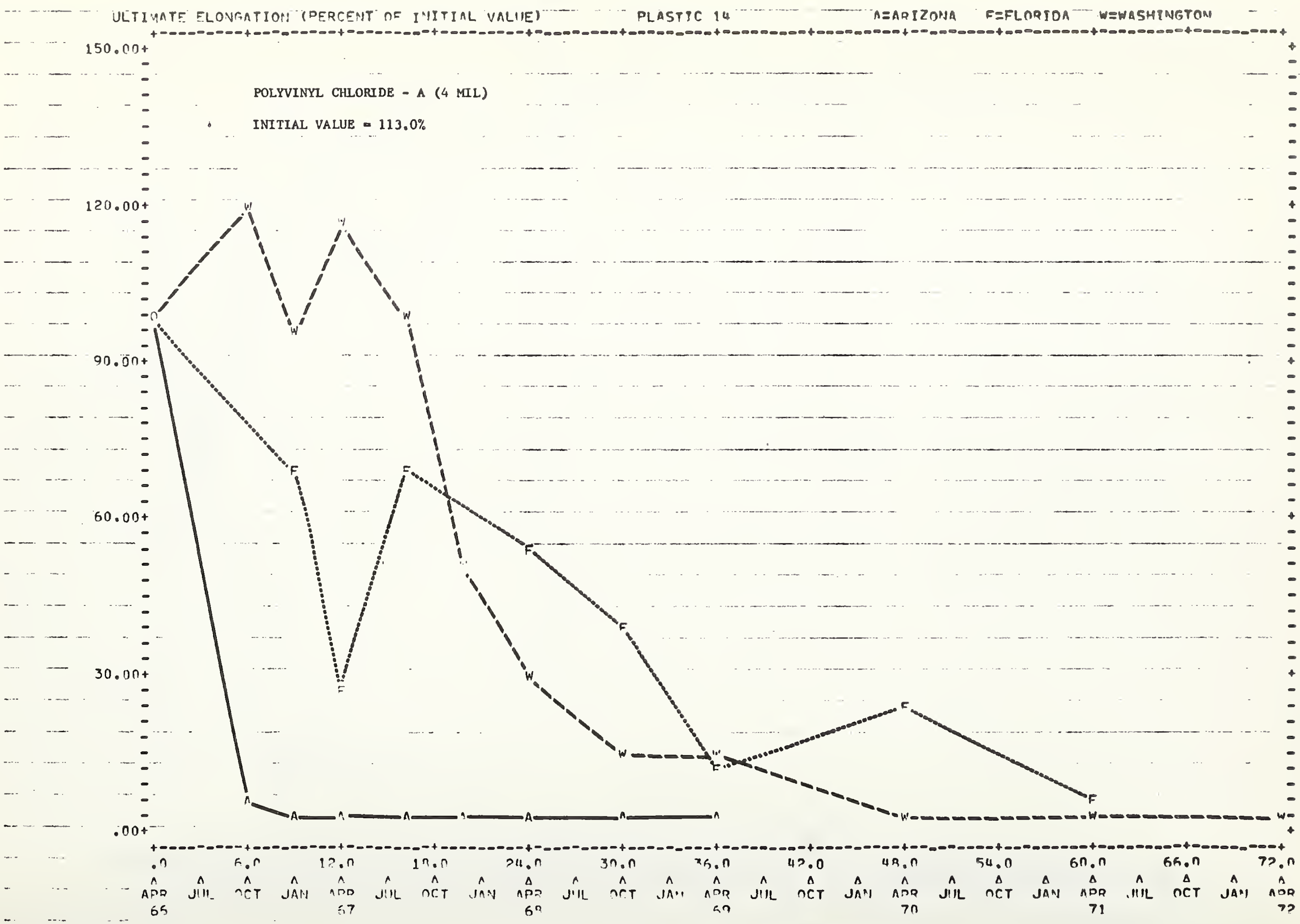

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 13
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - N (60 MIL)
INITIAL VALUE = 85.5%
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 65
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
W

FIGURE 34



**NOTE. 1 POINTS FELL OUTSIDE THE SPECIFIED LIMITS AND WERE OMITTED.

FIGURE 35

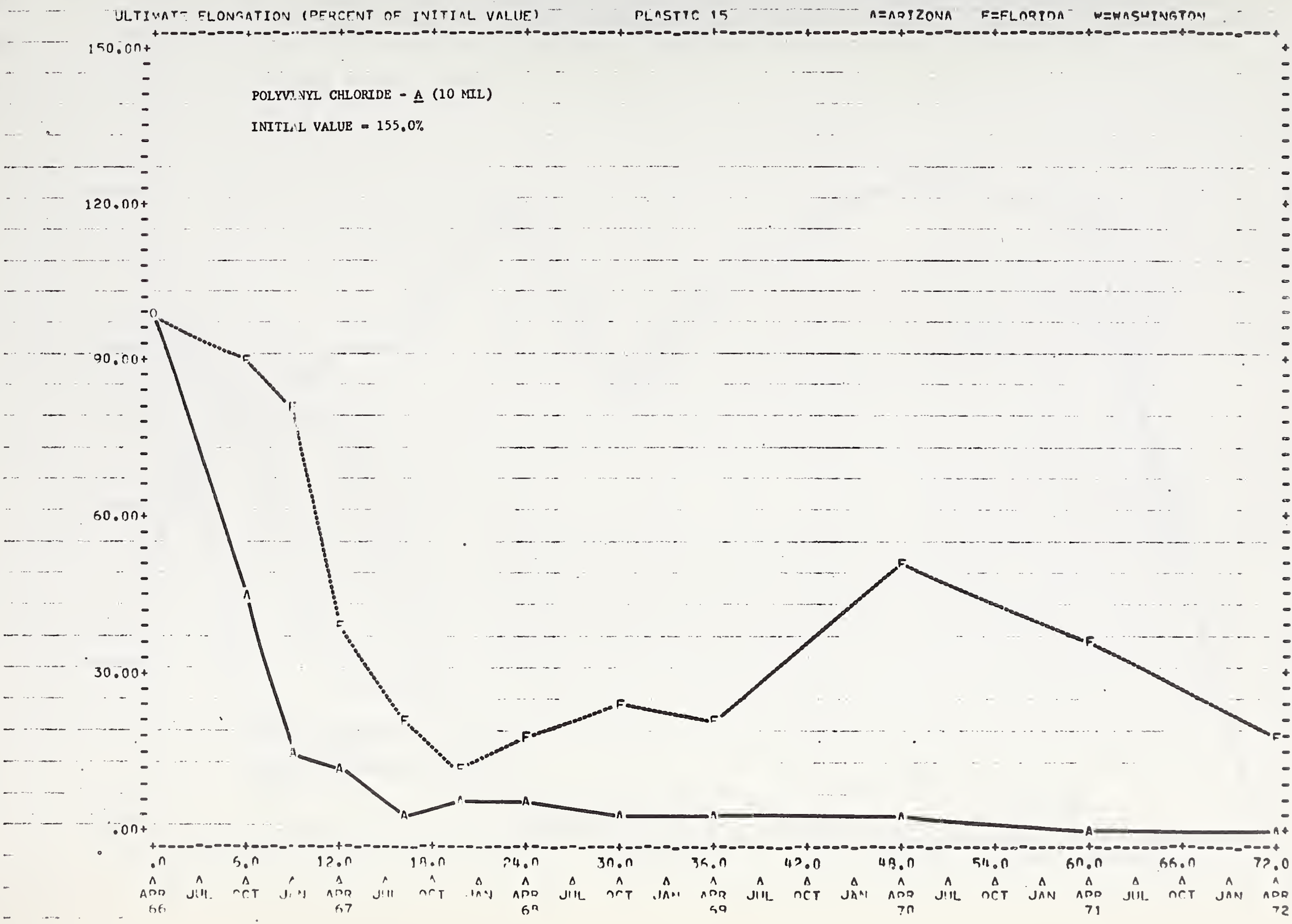

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 15
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - A (10 MIL)
INITIAL VALUE = 155.0%
150.00+
120.00+
90.00+
60.00+
30.00+
.00+
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 36

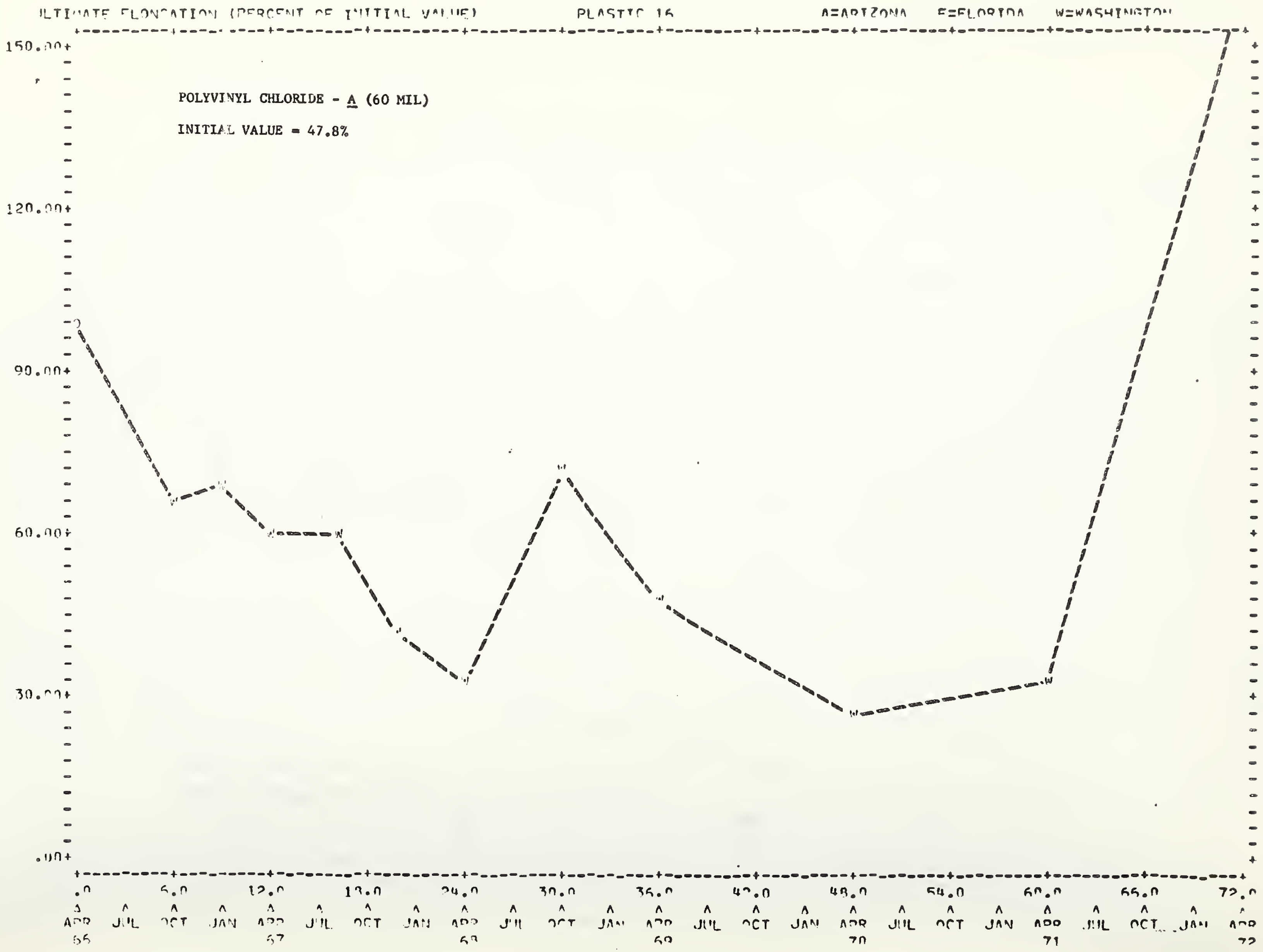

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 16
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - A (60 MIL)
INITIAL VALUE = 47.8%
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 37

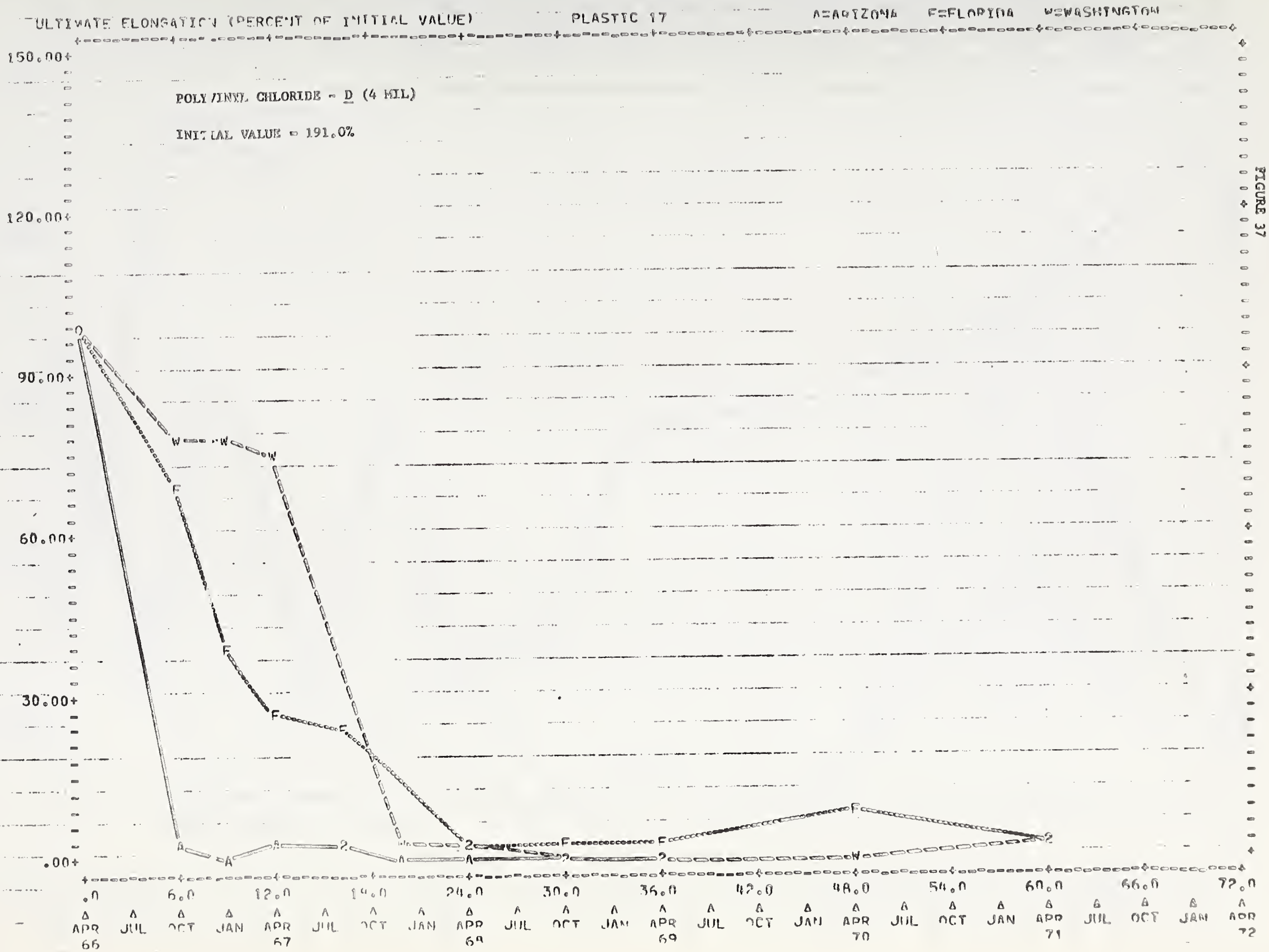

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 17
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - D (4 MIL)
INITIAL VALUE = 191.0%
150.00+
120.00+
90.00+
60.00+
30.00+
.00+
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 38

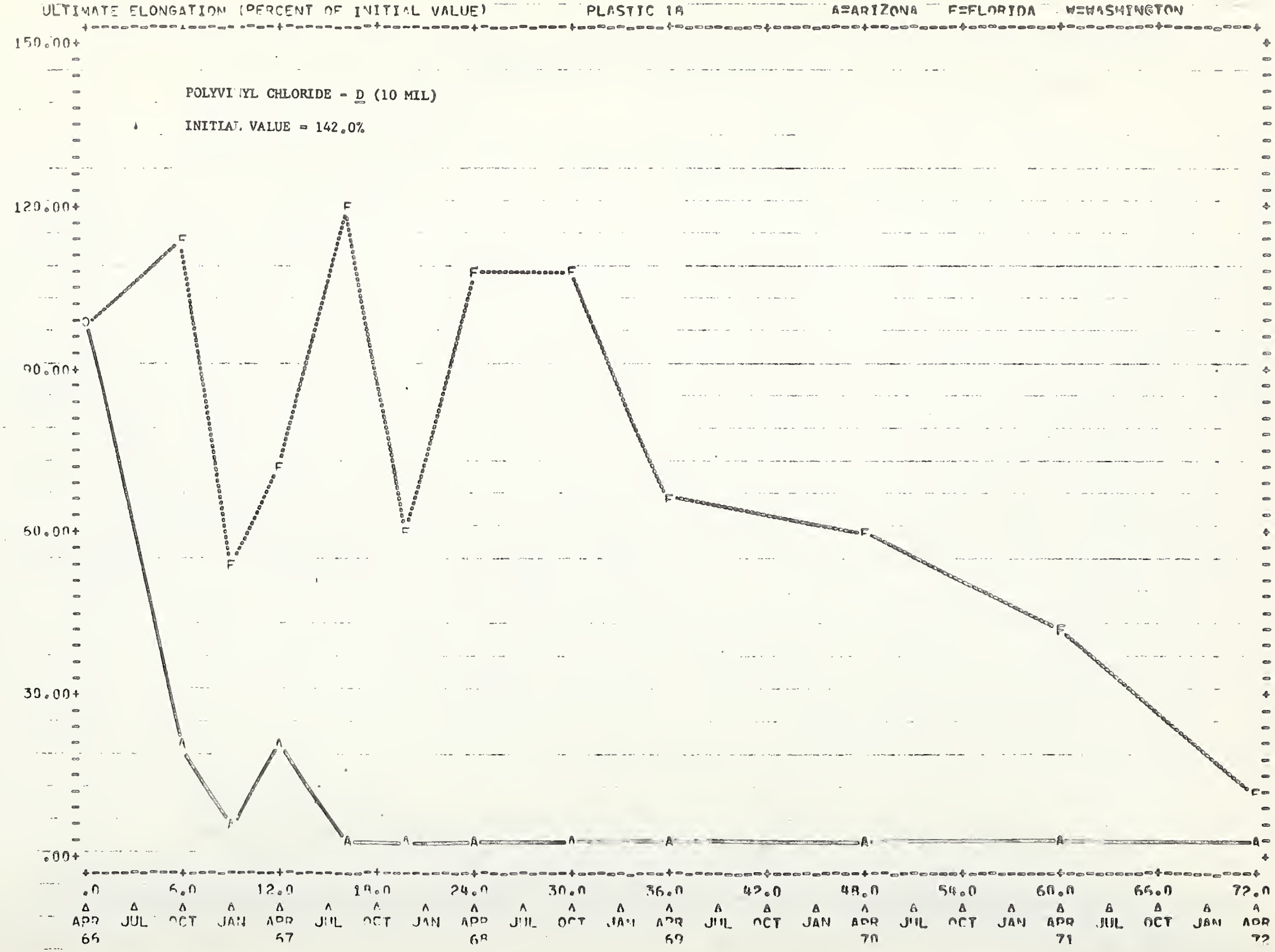

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 18
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - D (10 MIL)
INITIAL VALUE = 142.0%
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 39

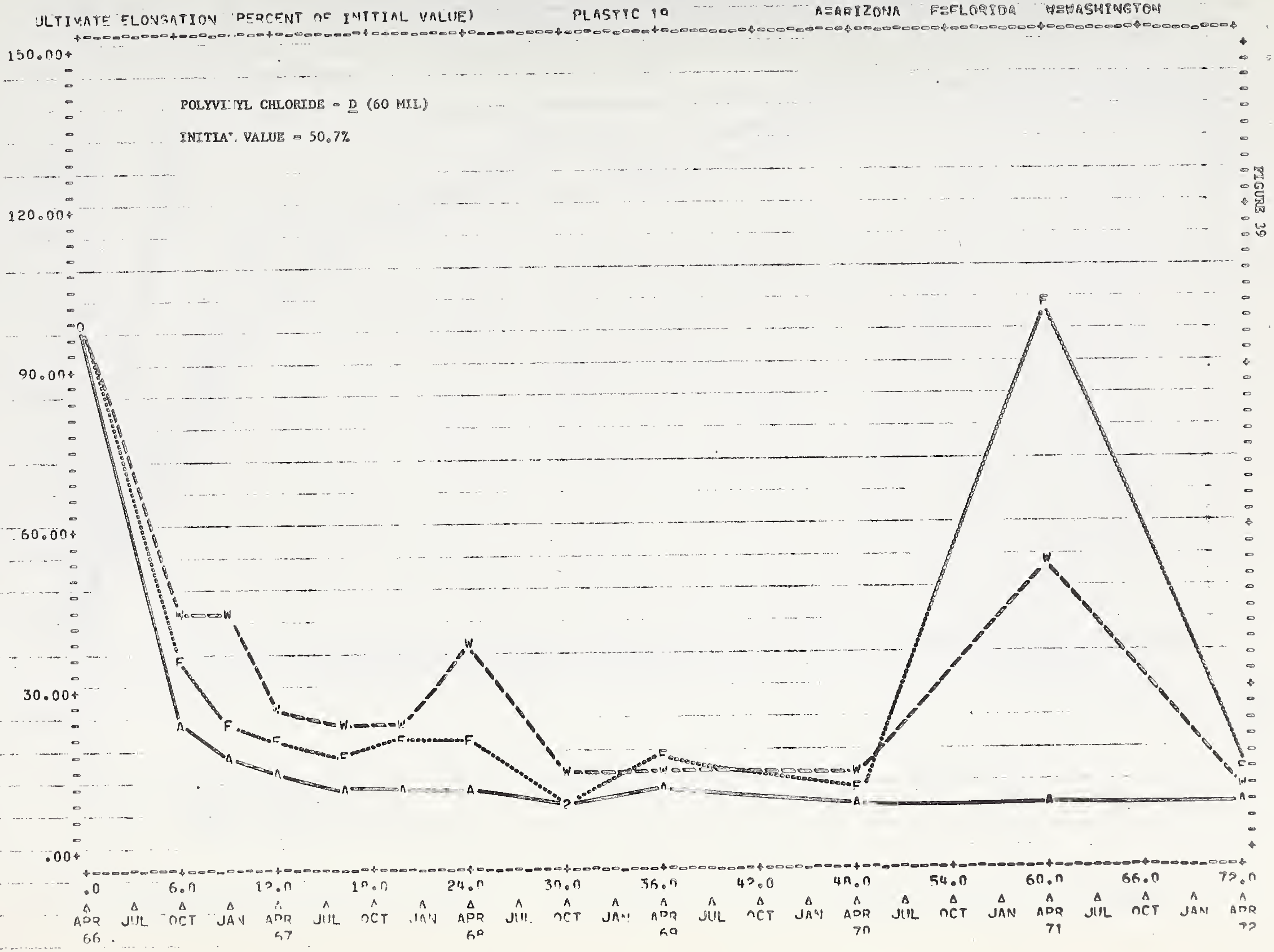

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 19
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - D (60 MIL)
INITIAL VALUE = 50.7%
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
W

FIGURE 40

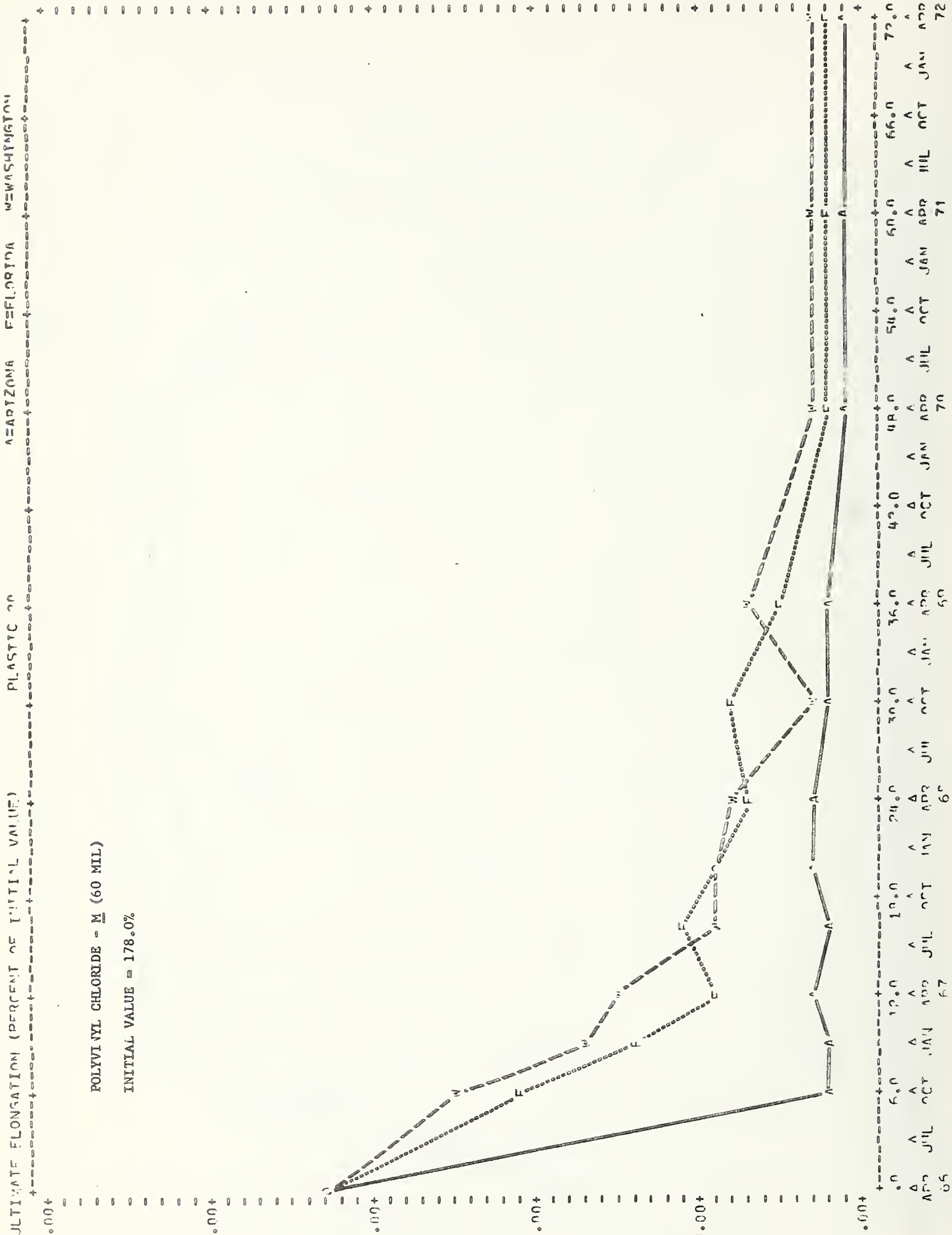

ULTIMATE ELONGATION (PERCENT OF INITIAL VALUE)
PLASTIC 20
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - M (60 MIL)
INITIAL VALUE = 178.0%
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 65
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 41

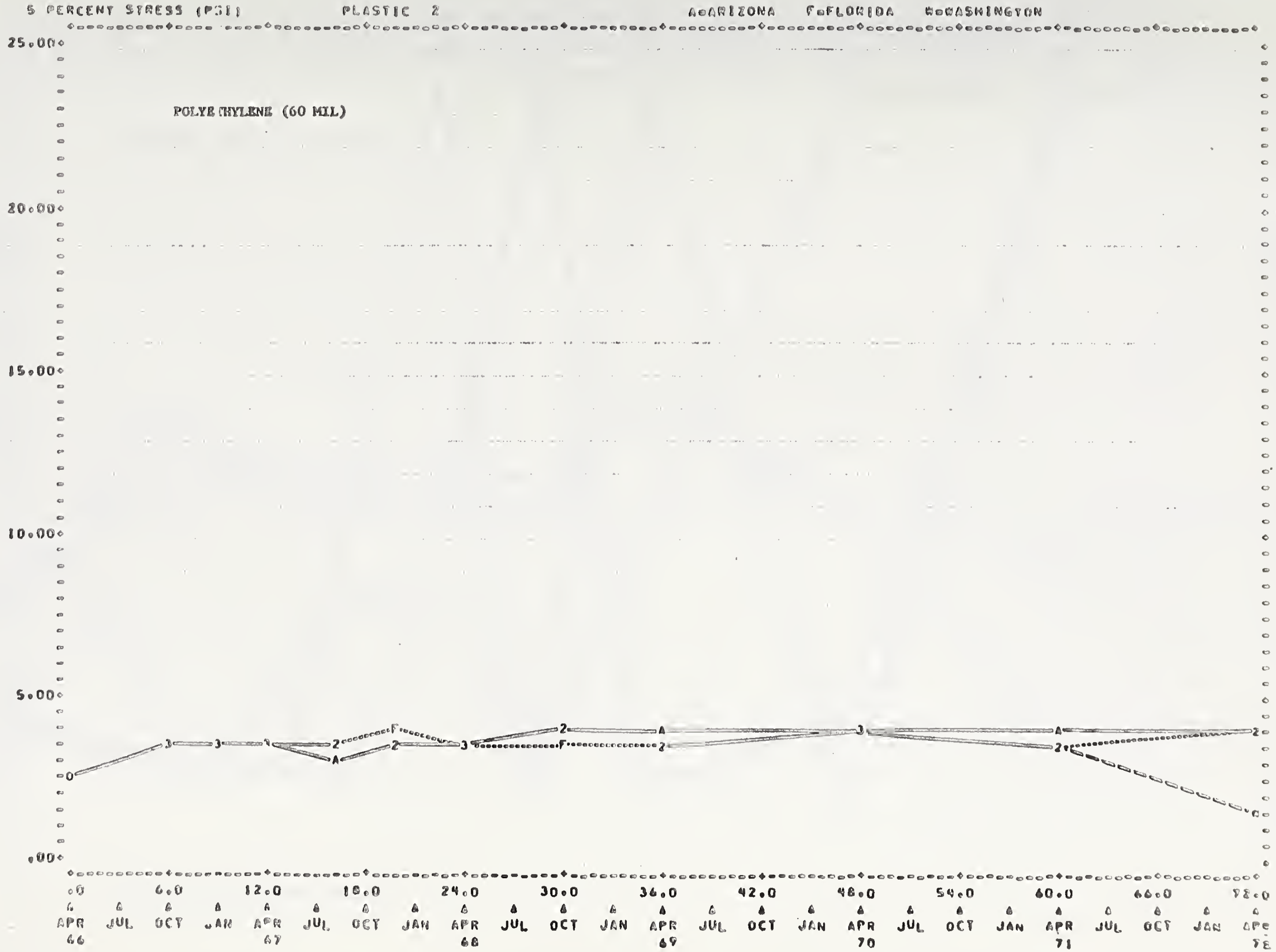
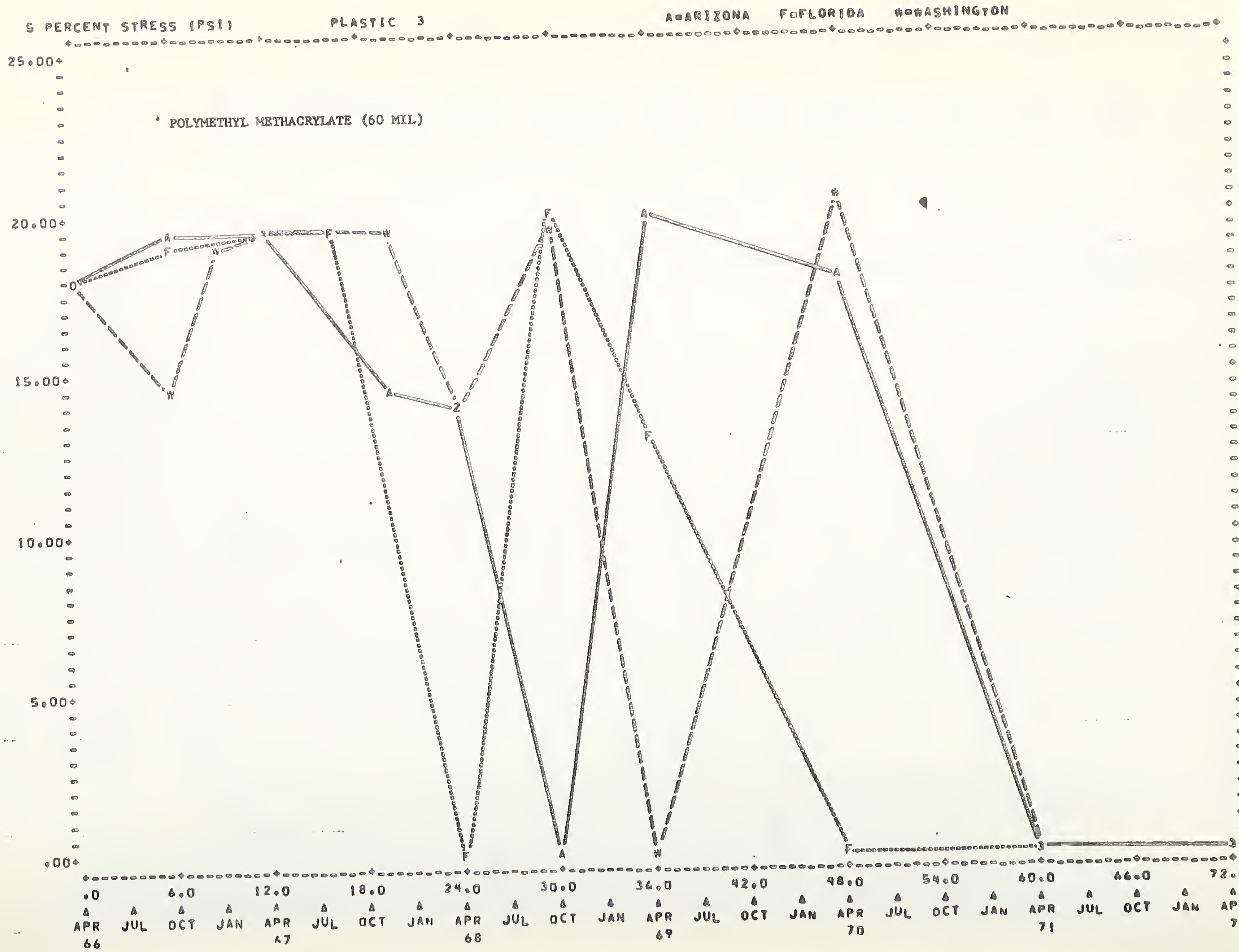
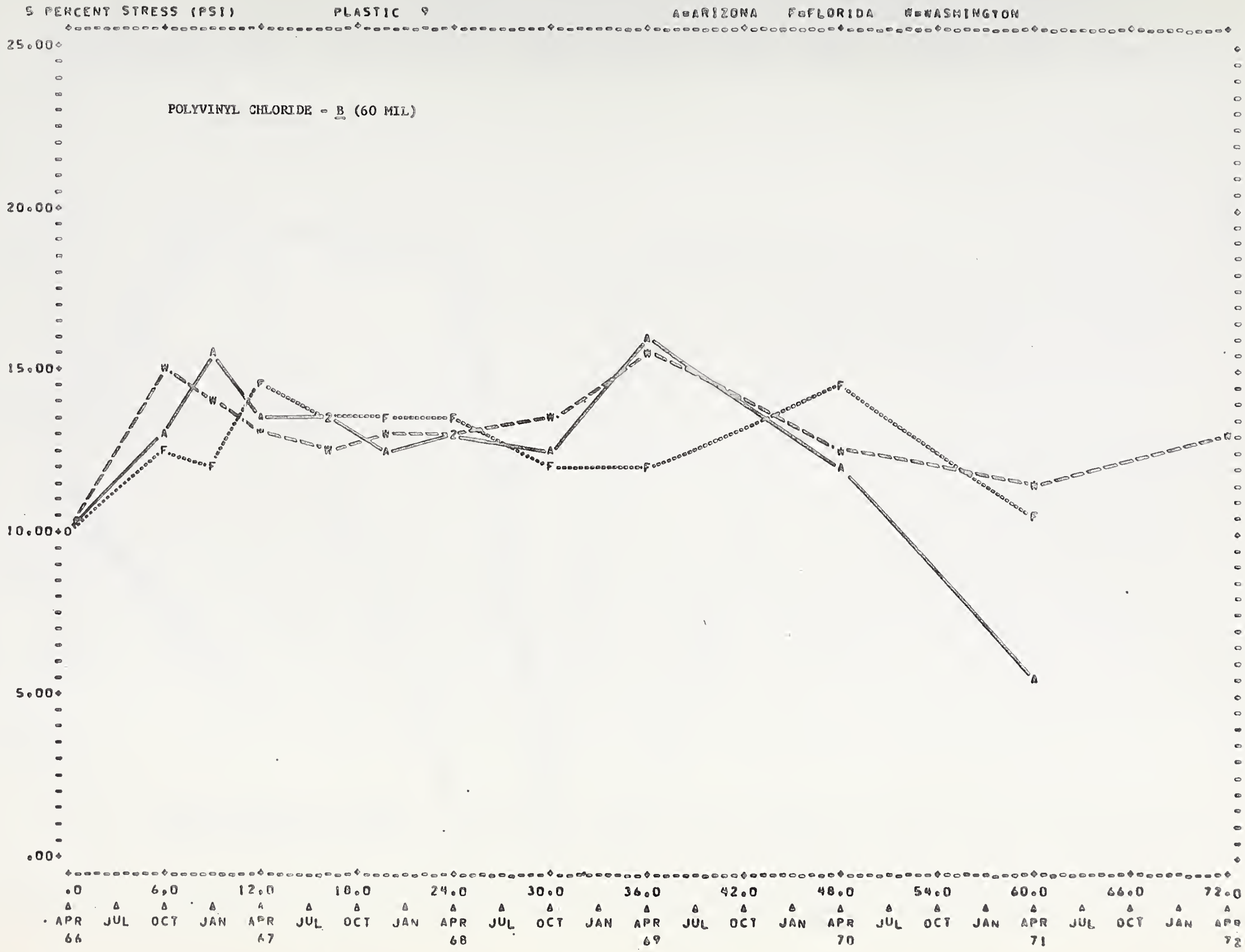

5 PERCENT STRESS (PSI)
PLASTIC 2
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYETHYLENE (60 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 42



5 PERCENT STRESS (PSI)
PLASTIC 3
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYMETHYL METHACRYLATE (60 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 47
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
W

FIGURE 43



**NOTE. 1 POINTS FELL OUTSIDE THE SPECIFIED LIMITS AND WERE OMITTED.

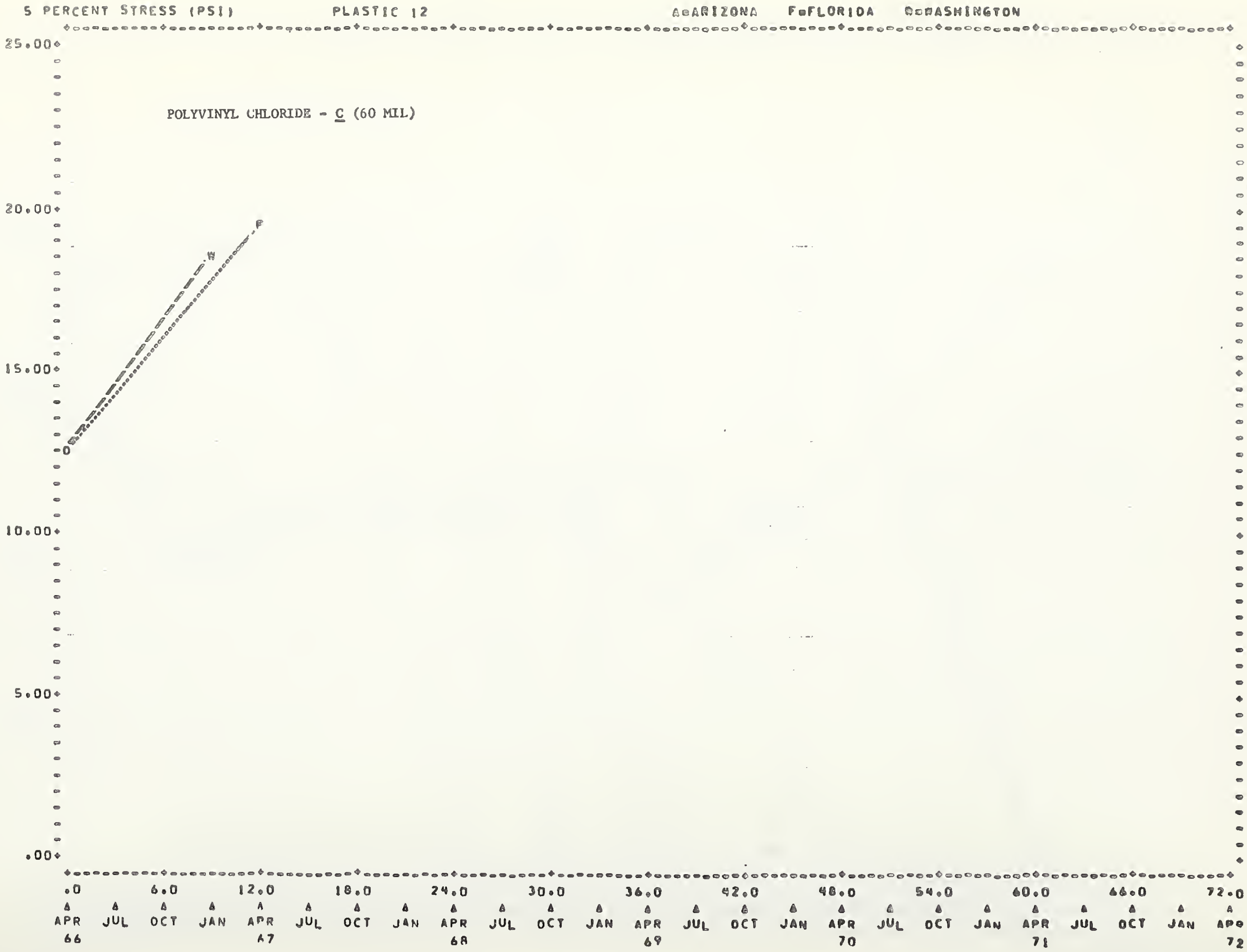

5 PERCENT STRESS (PSI)
PLASTIC 12
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - C (60 MIL)
25.00
20.00
15.00
10.00
5.00
.00
0
W
F
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 44

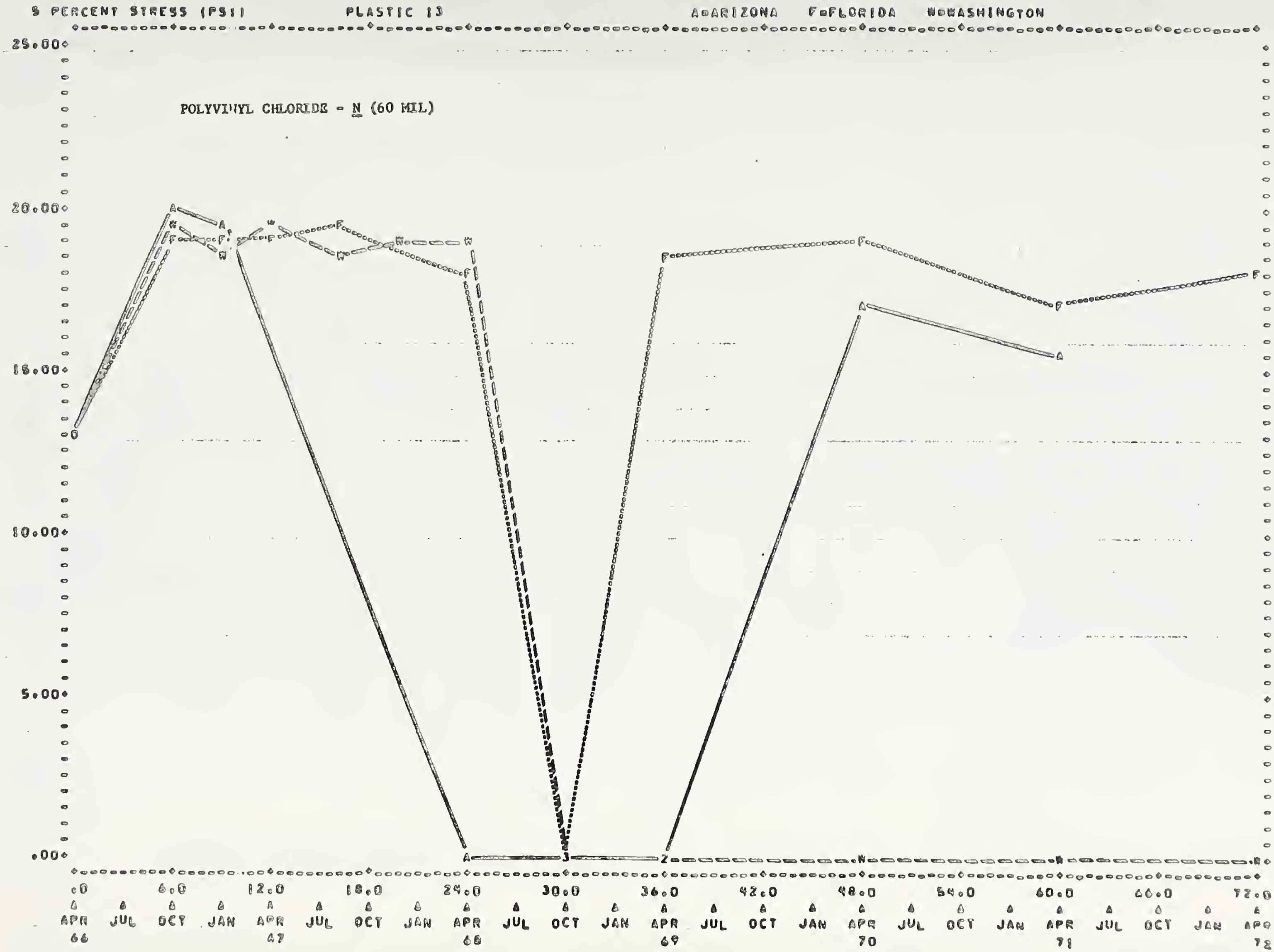

5 PERCENT STRESS (PSI)
PLASTIC 13
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - N (60 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0 APR 66
JUL
6.0 OCT
JAN
12.0 APR 67
JUL
18.0 OCT
JAN
24.0 APR 68
JUL
30.0 OCT
JAN
36.0 APR 69
JUL
42.0 OCT
JAN
48.0 APR 70
JUL
54.0 OCT
JAN
60.0 APR 71
JUL
66.0 OCT
JAN
72.0 APR 72

FIGURE 45

FIGURE 46

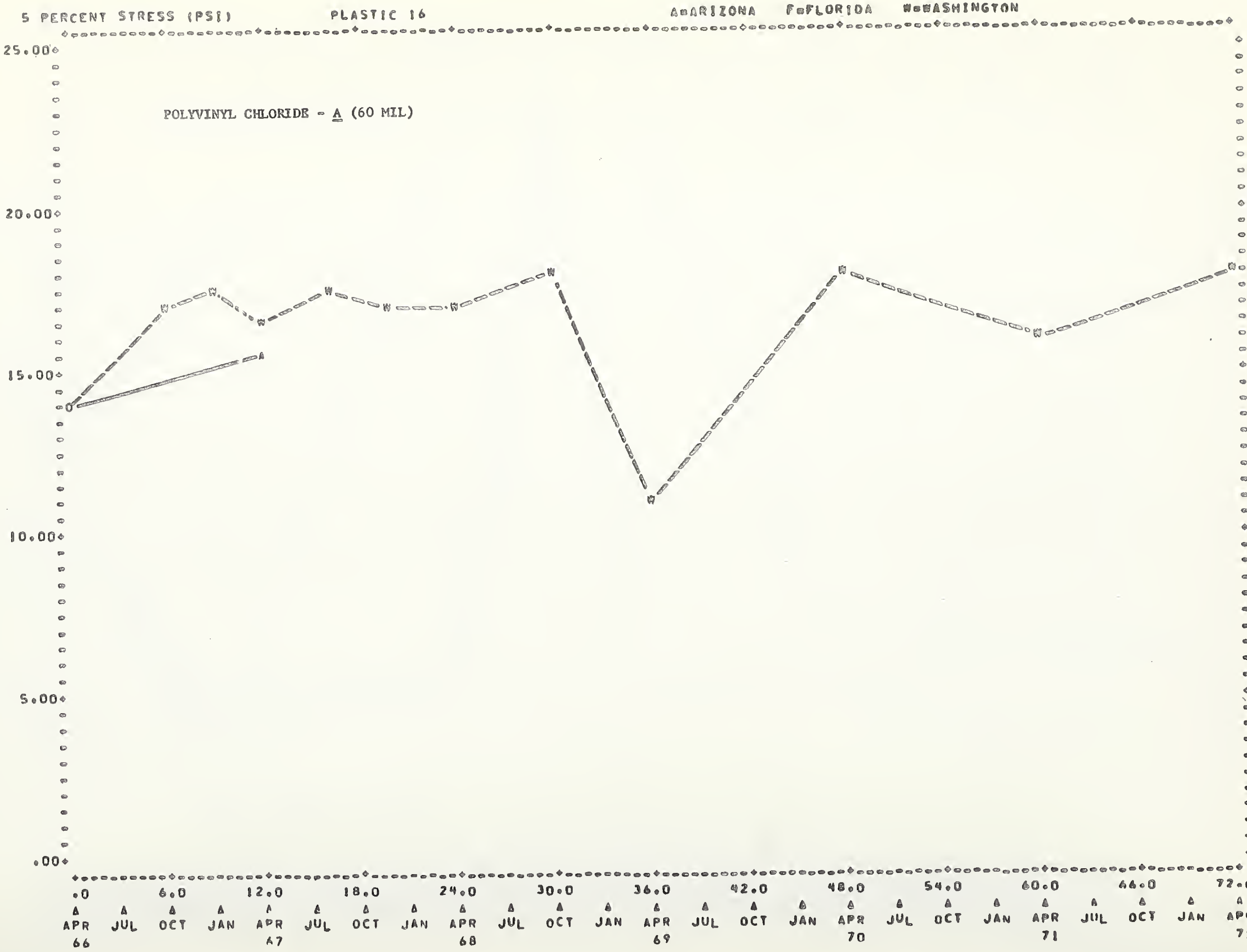

5 PERCENT STRESS (PSI)
PLASTIC 16
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - A (60 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 47

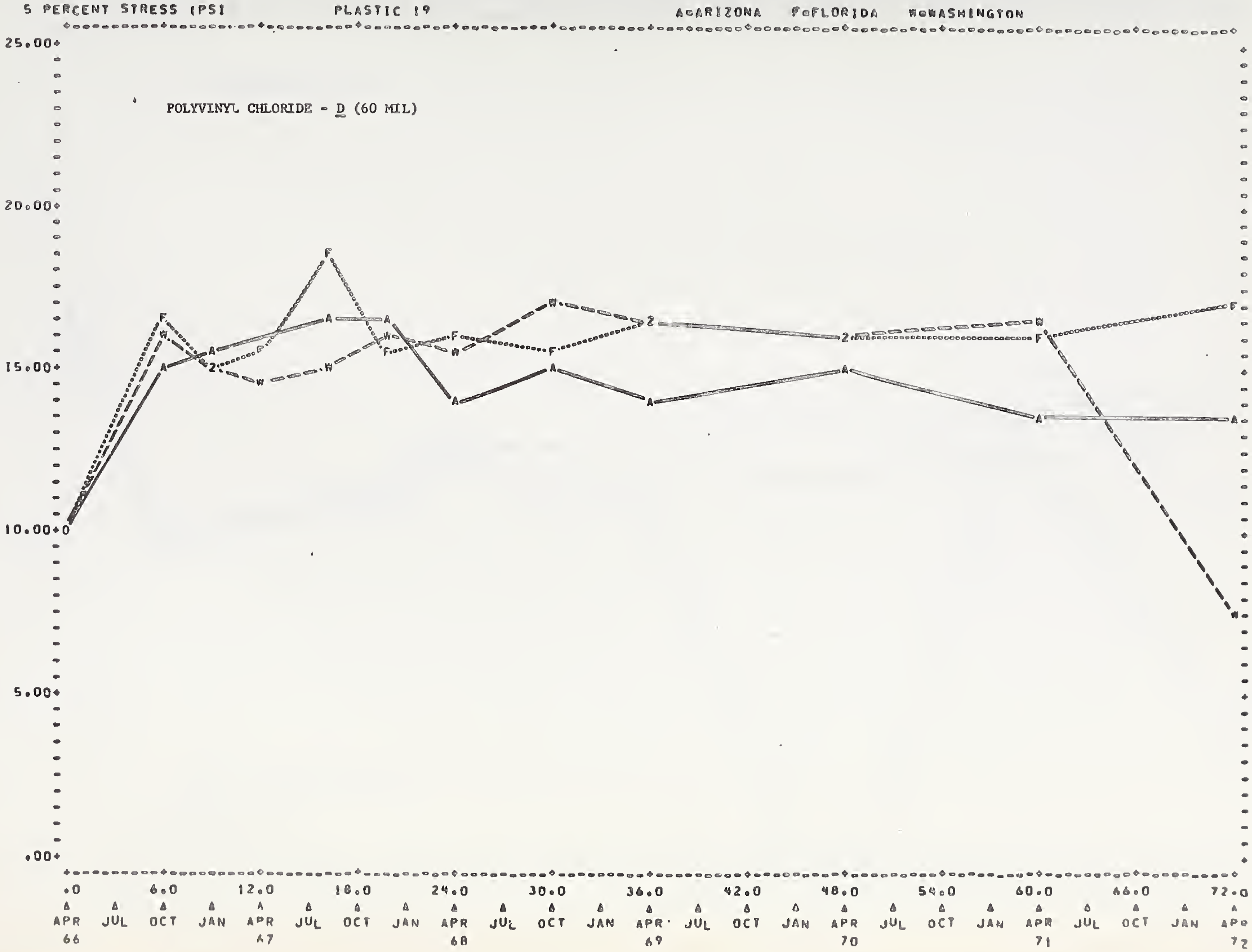
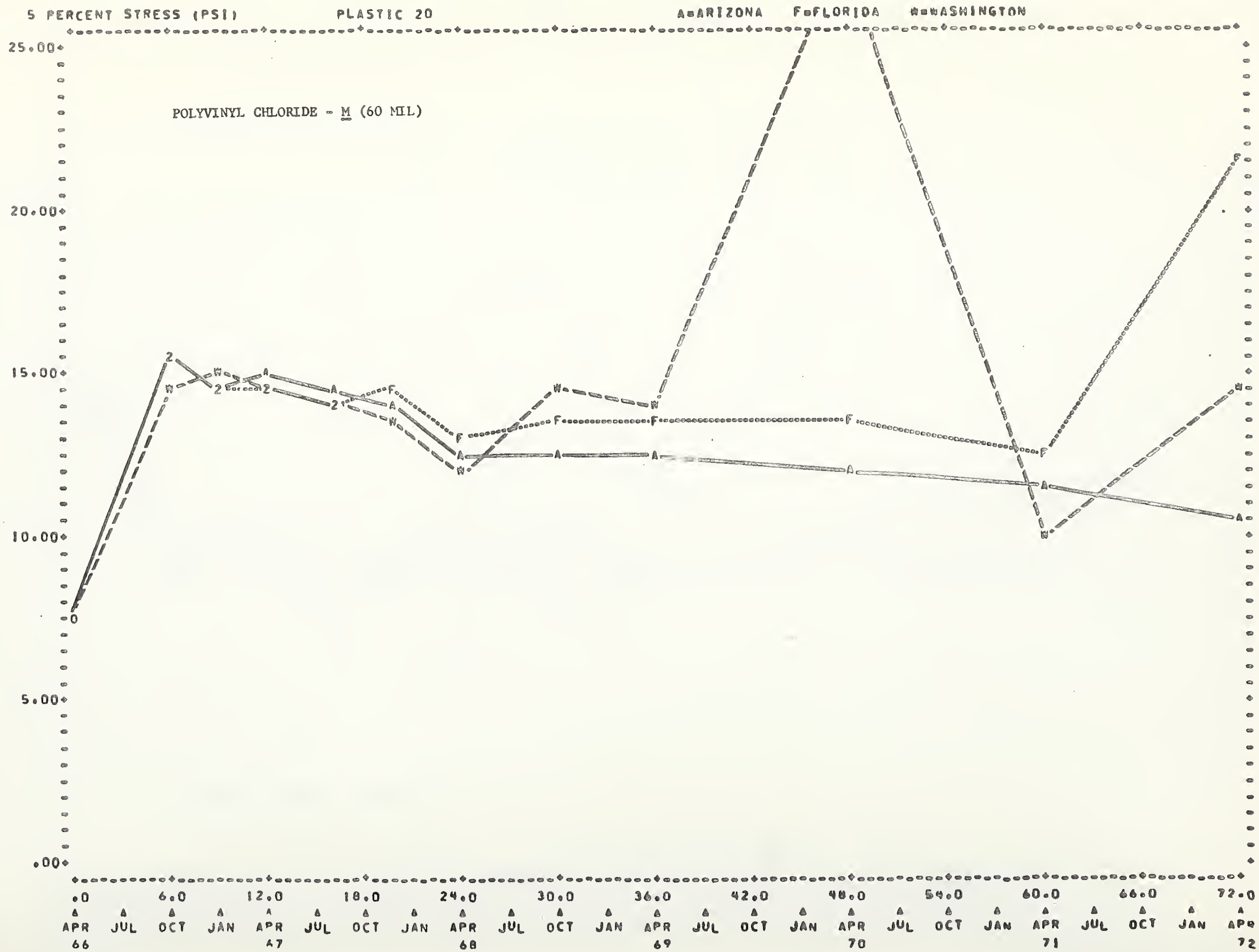

5 PERCENT STRESS (PSI)
PLASTIC 19
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - D (60 MIL)
25.00
20.00
15.00
10.00
5.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 48



**NOTE. 1 POINTS FELL OUTSIDE THE SPECIFIED LIMITS AND WERE OMITTED.

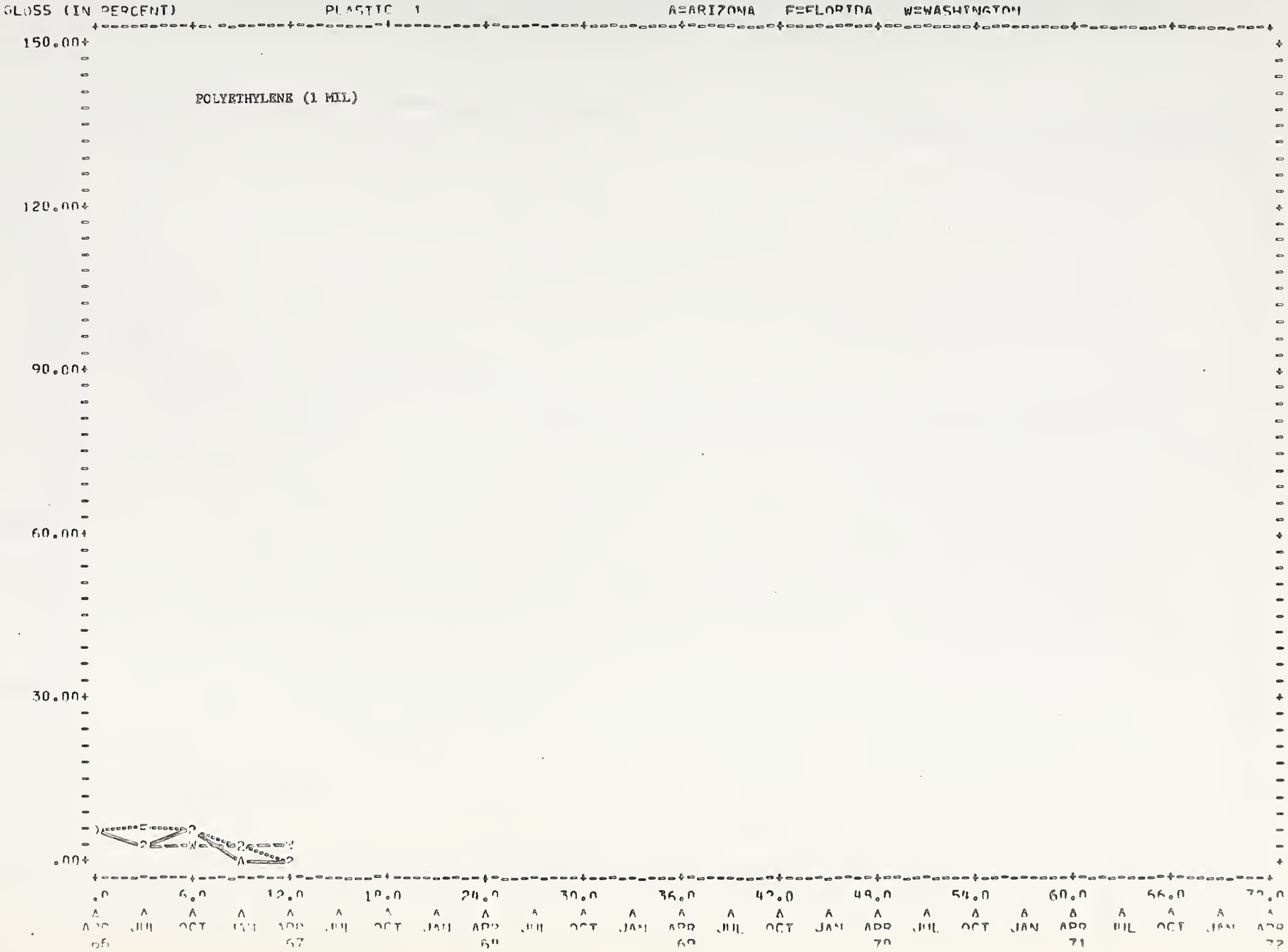

GLOSS (IN PERCENT)
PLASTIC 1
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYETHYLENE (1 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 49

FIGURE 50

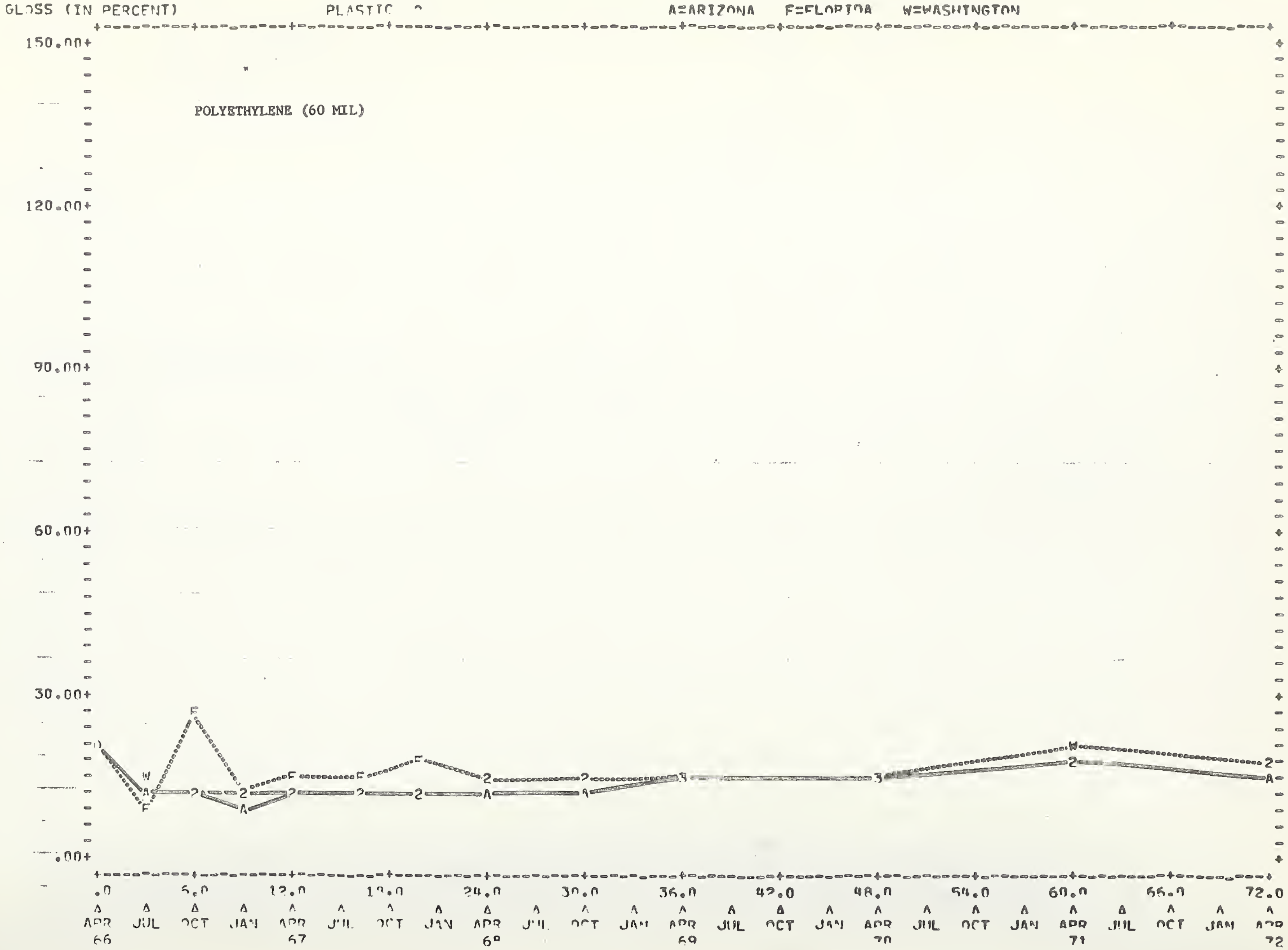

GLOSS (IN PERCENT)
PLASTIC
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYETHYLENE (60 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
W
2
3

FIGURE 51

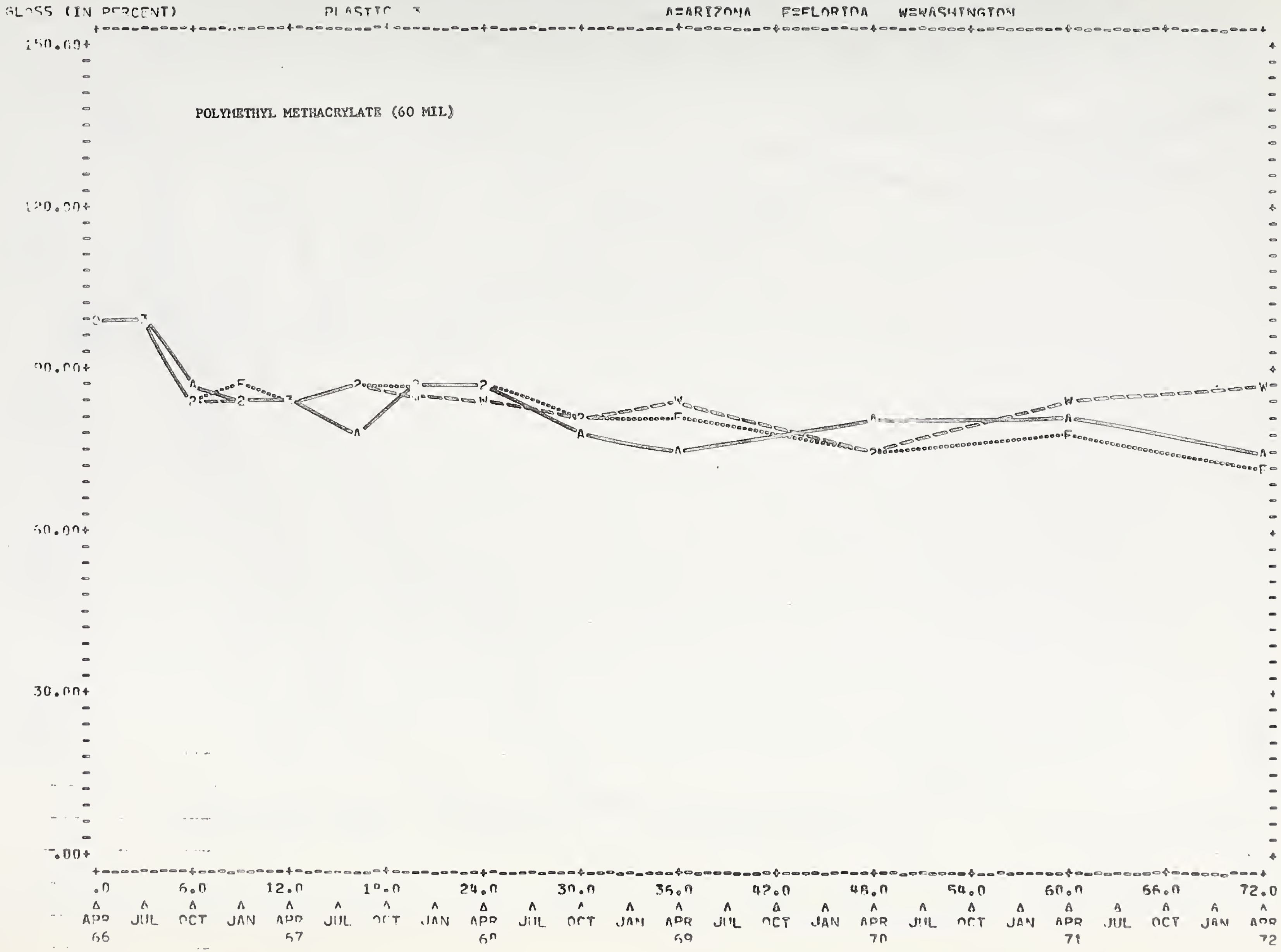

GLOSS (IN PERCENT)
PLASTIC 3
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYMETHYL METHACRYLATE (60 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 52

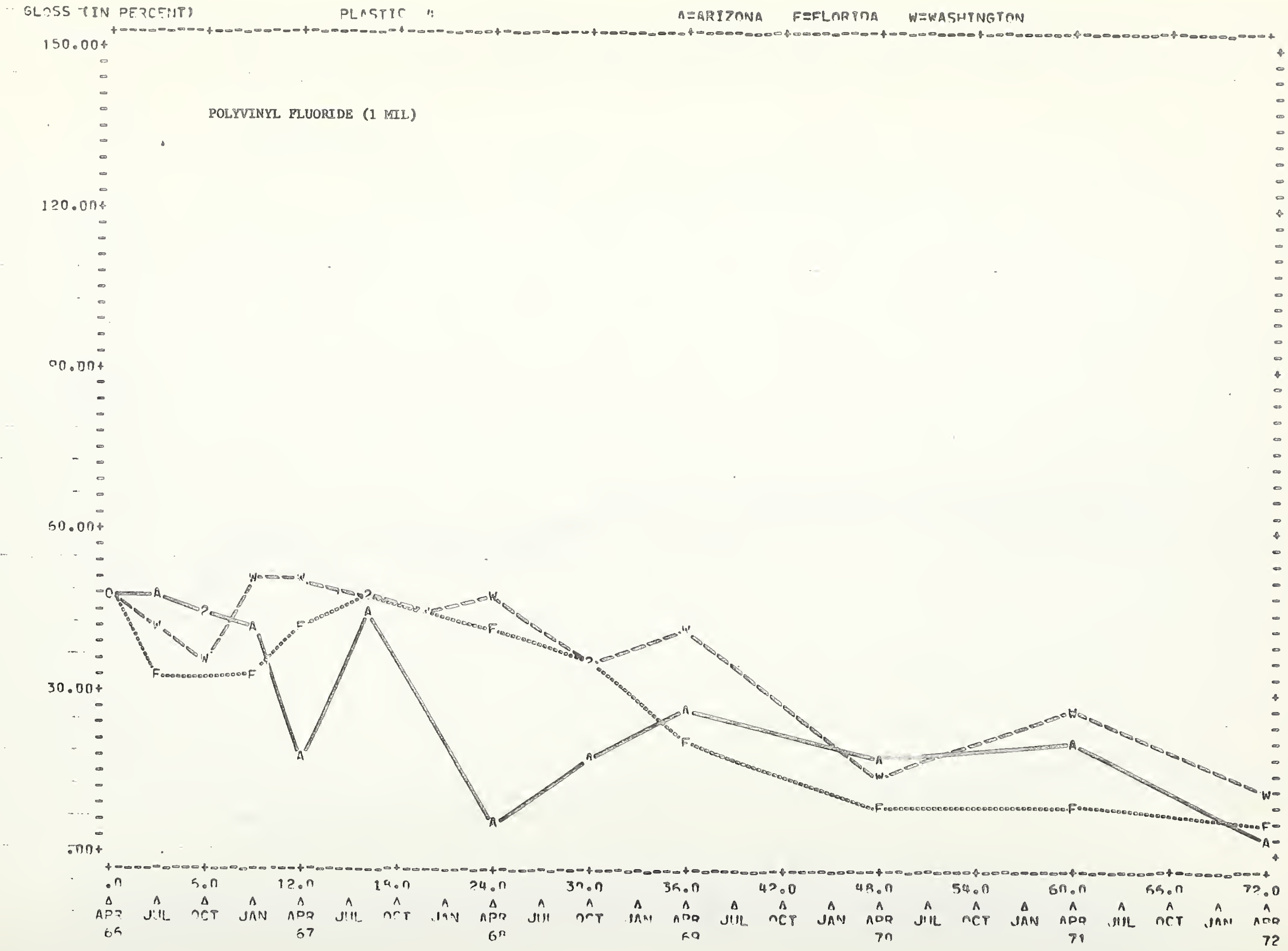

GLOSS (IN PERCENT)
PLASTIC 8
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL FLUORIDE (1 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 53

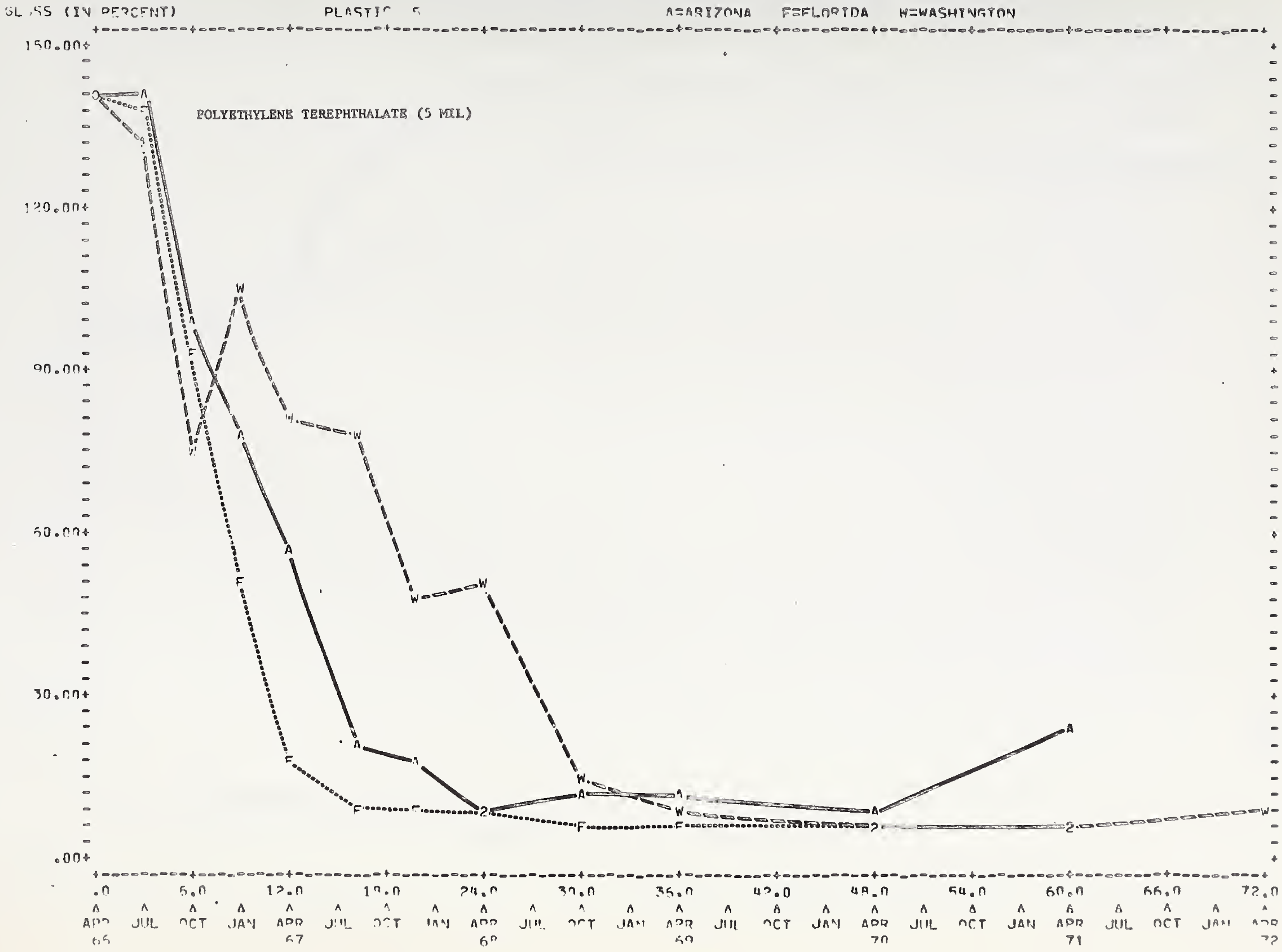

GLOSS (IN PERCENT)
PLASTIC 5
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYETHYLENE TEREPHTHALATE (5 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 65
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
W
2

FIGURE 54

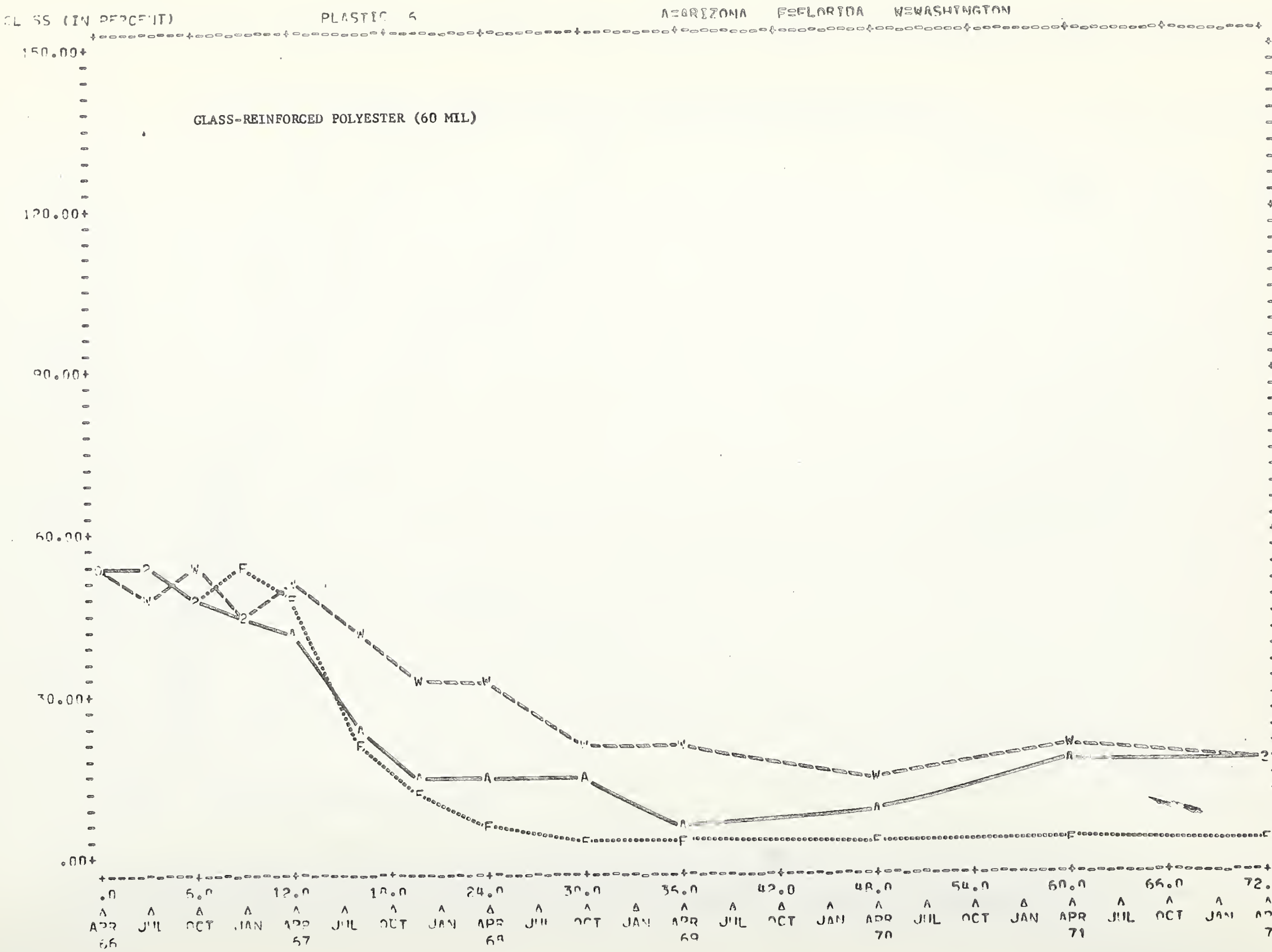
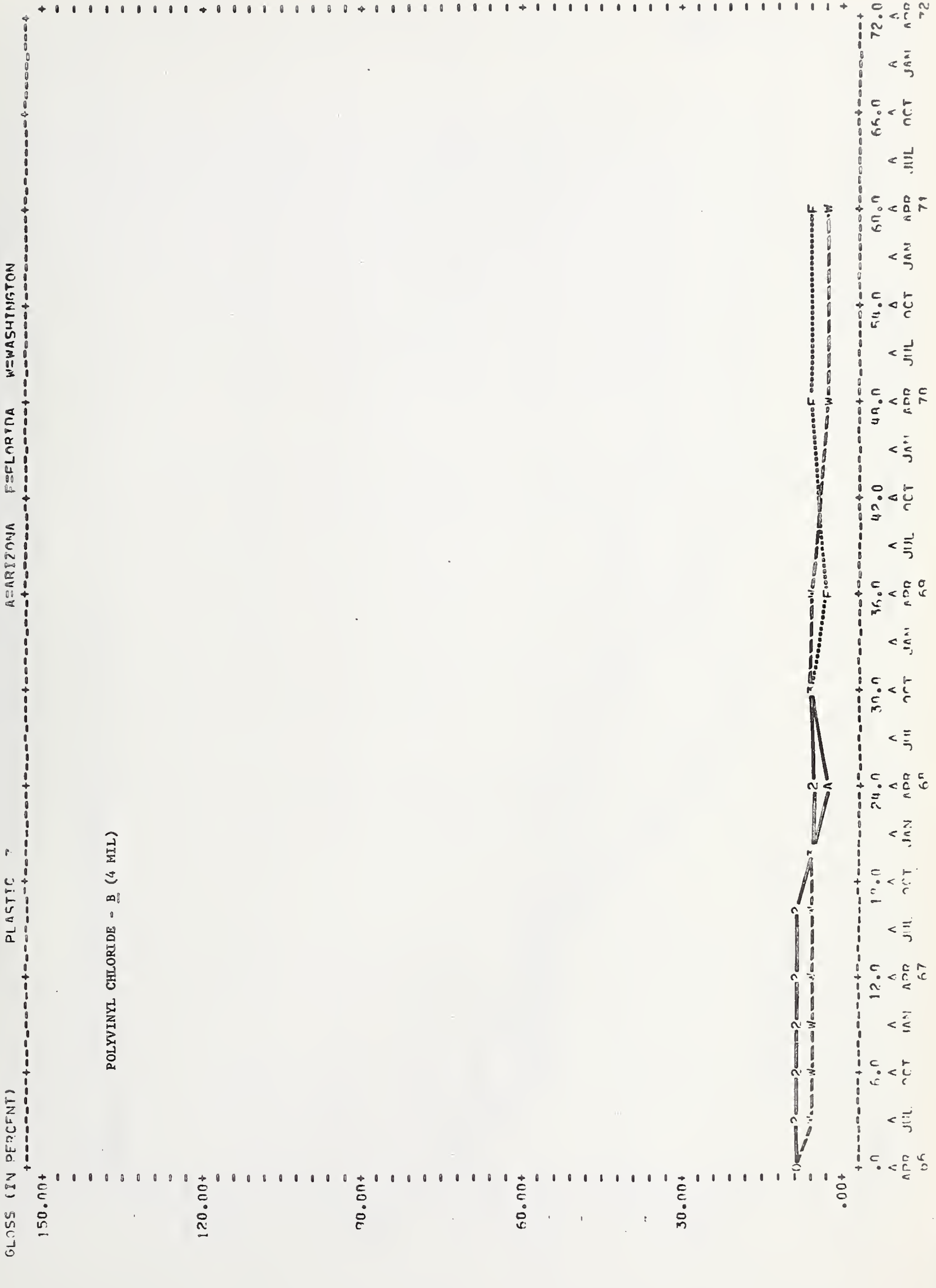

GLOSS (IN PERCENT)
PLASTIC 6
A=ARIZONA F=FLORIDA W=WASHINGTON
GLASS-REINFORCED POLYESTER (60 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 55


GLOSS (IN PERCENT)
PLASTIC 7
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - B (4 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

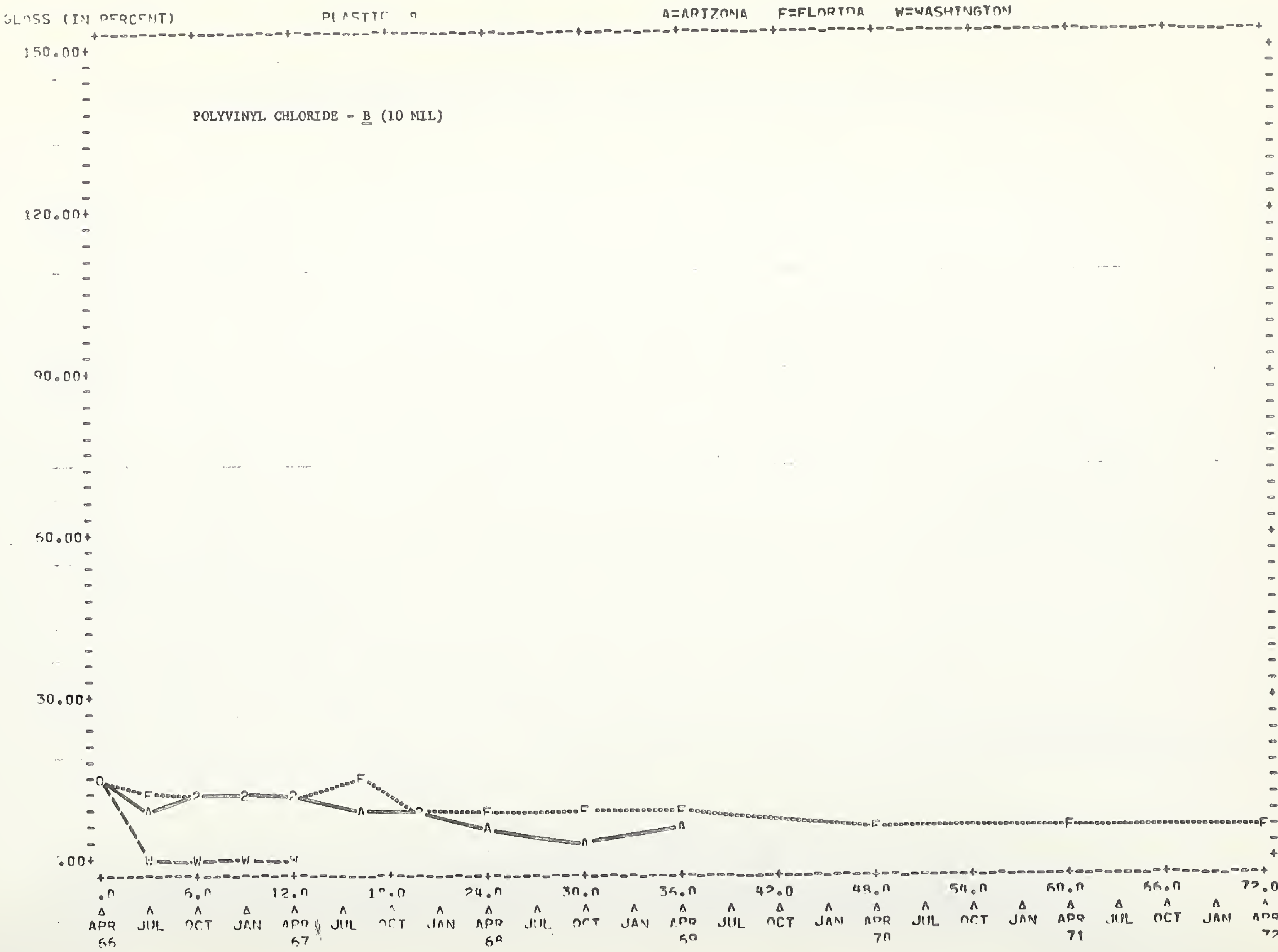

GLOSS (IN PERCENT)
PLASTIC 9
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - B (10 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 56

FIGURE 57

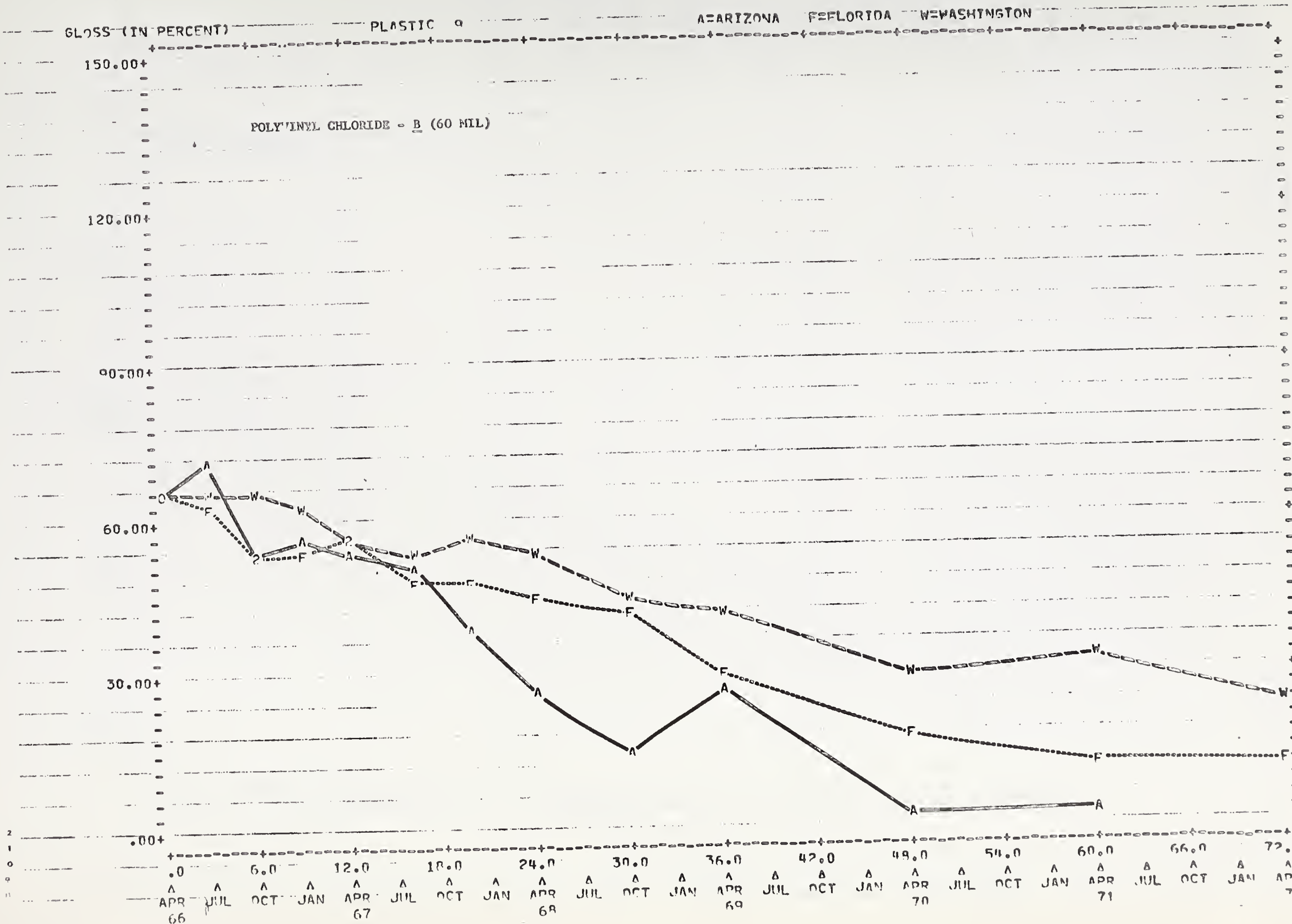

GLOSS (IN PERCENT)
PLASTIC 9
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - B (60 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 58

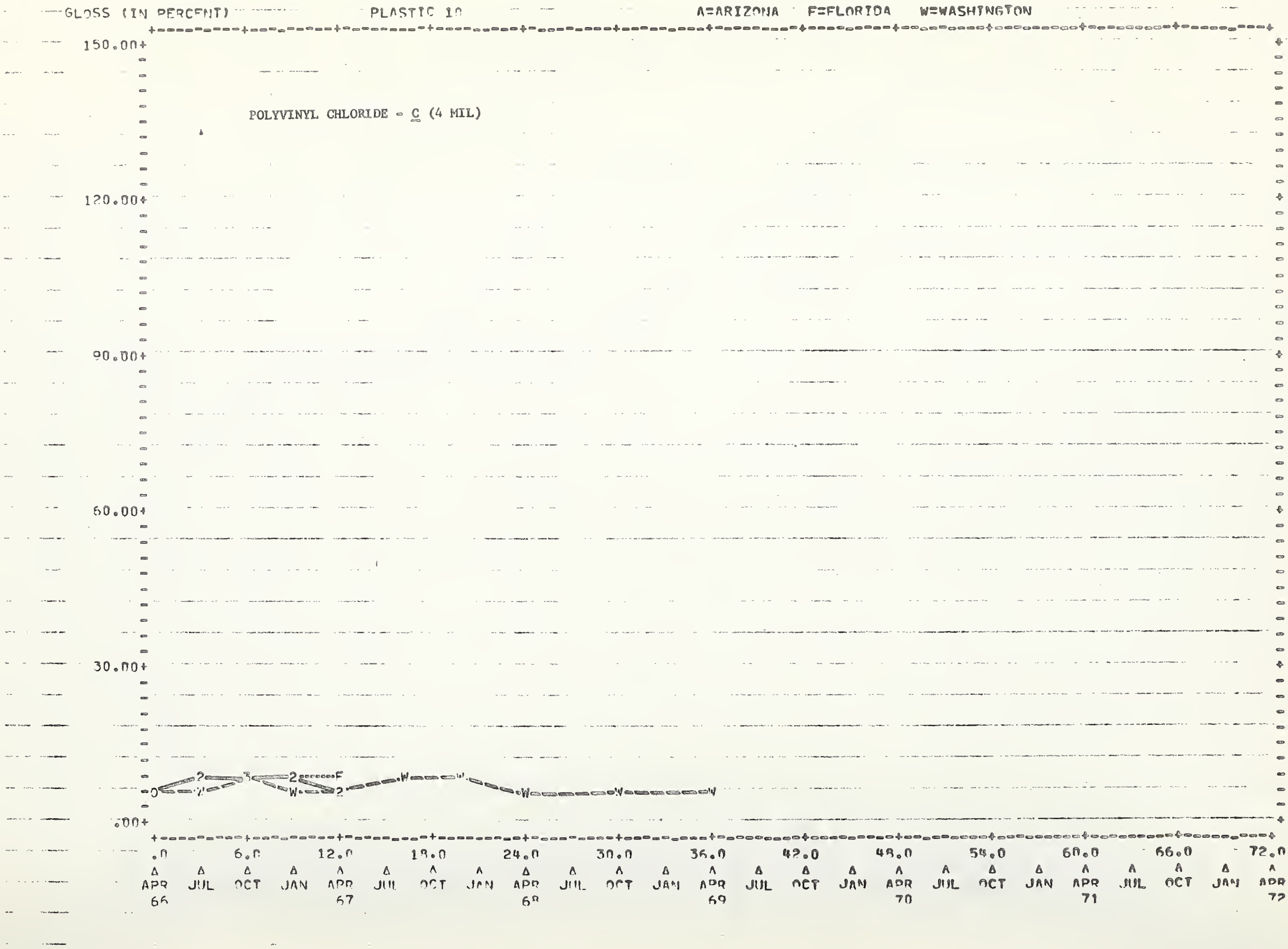
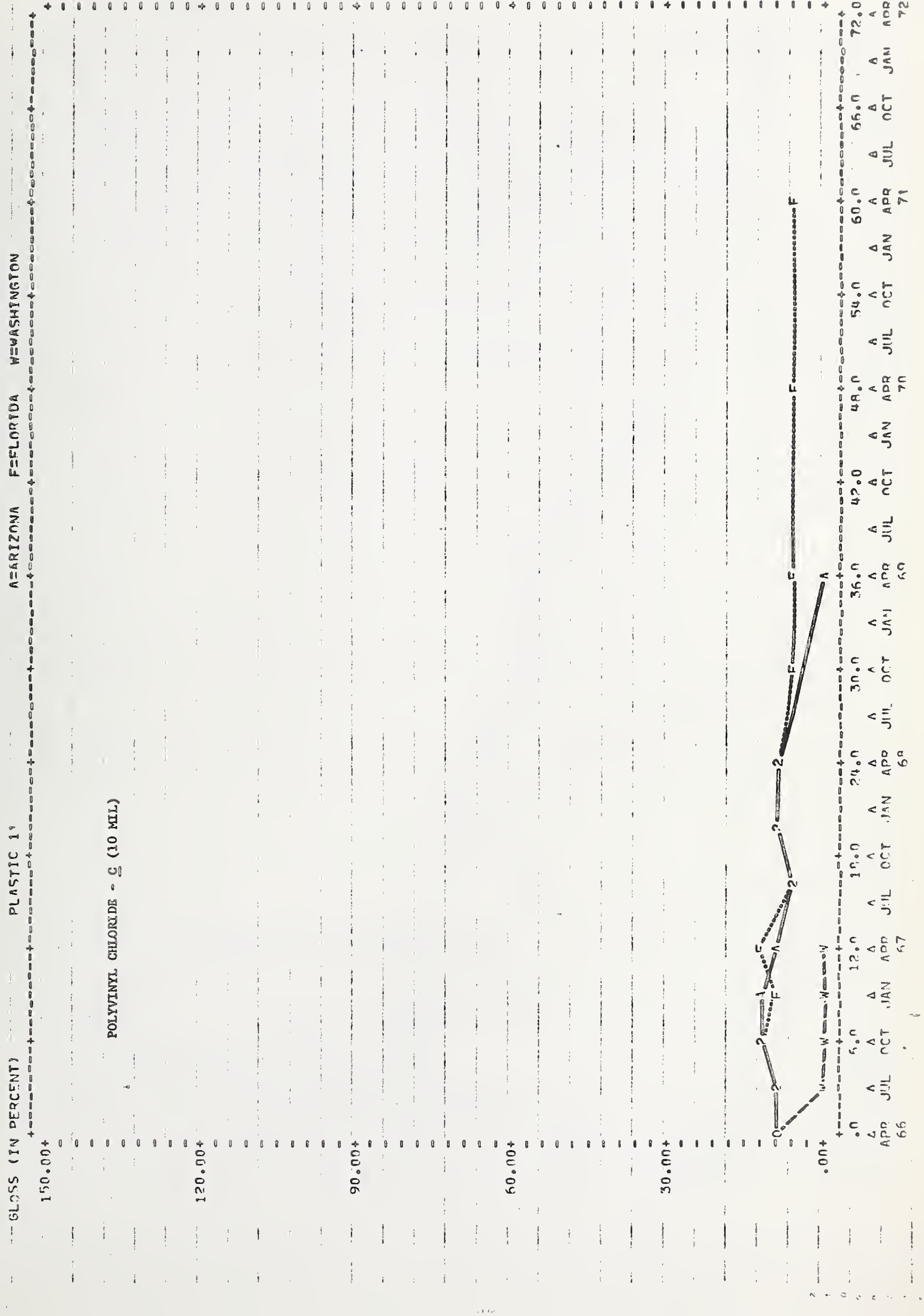

GLOSS (IN PERCENT)
PLASTIC 10
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - C (4 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0 6.0 12.0 18.0 24.0 30.0 36.0 42.0 48.0 54.0 60.0 66.0 72.0
APR 66 JUL OCT JAN APR 67 JUL OCT JAN APR 68 JUL OCT JAN APR 69 JUL OCT JAN APR 70 JUL OCT JAN APR 71 JUL OCT JAN APR 72
2 3 2 F W 2 W W W W W
0

FIGURE 59


GLOSS (IN PERCENT)
PLASTIC 19
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - C (10 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

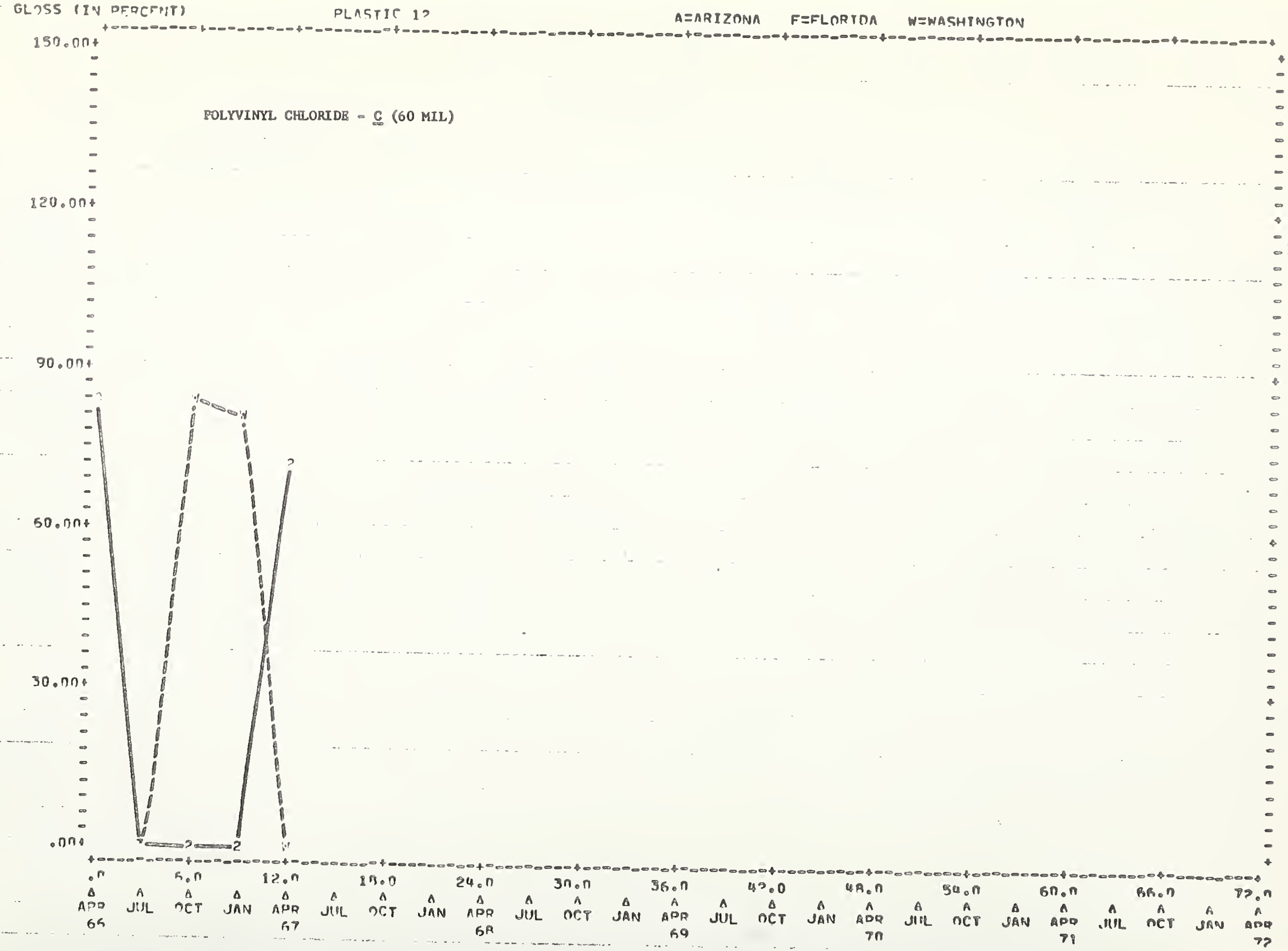

GLOSS (IN PERCENT)
PLASTIC 12
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - C (60 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
2
W

FIGURE 60

FIGURE 61

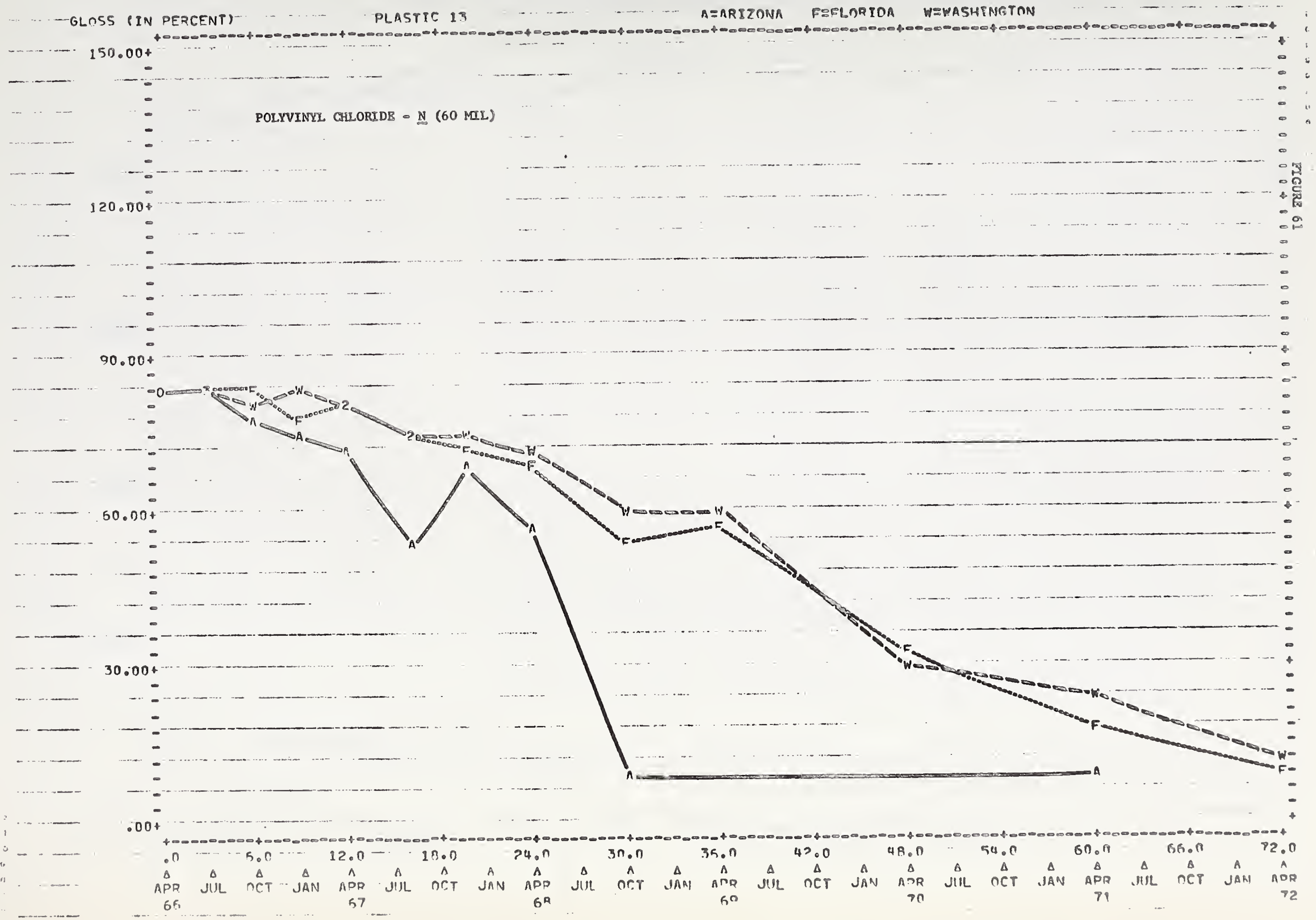

GLOSS (IN PERCENT)
PLASTIC 13
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - N (60 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 62

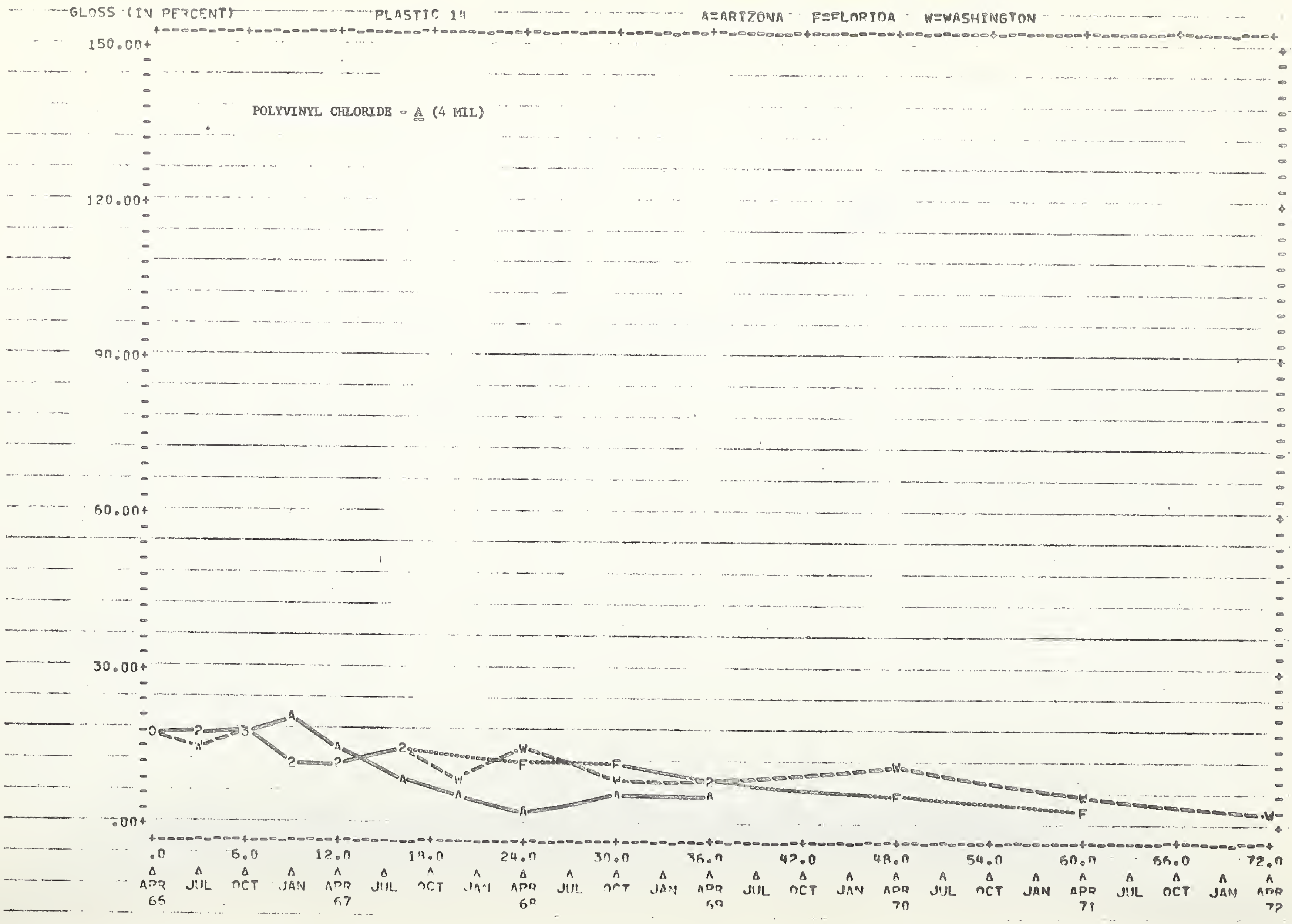

GLOSS (IN PERCENT)
PLASTIC 19
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - A (4 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 63

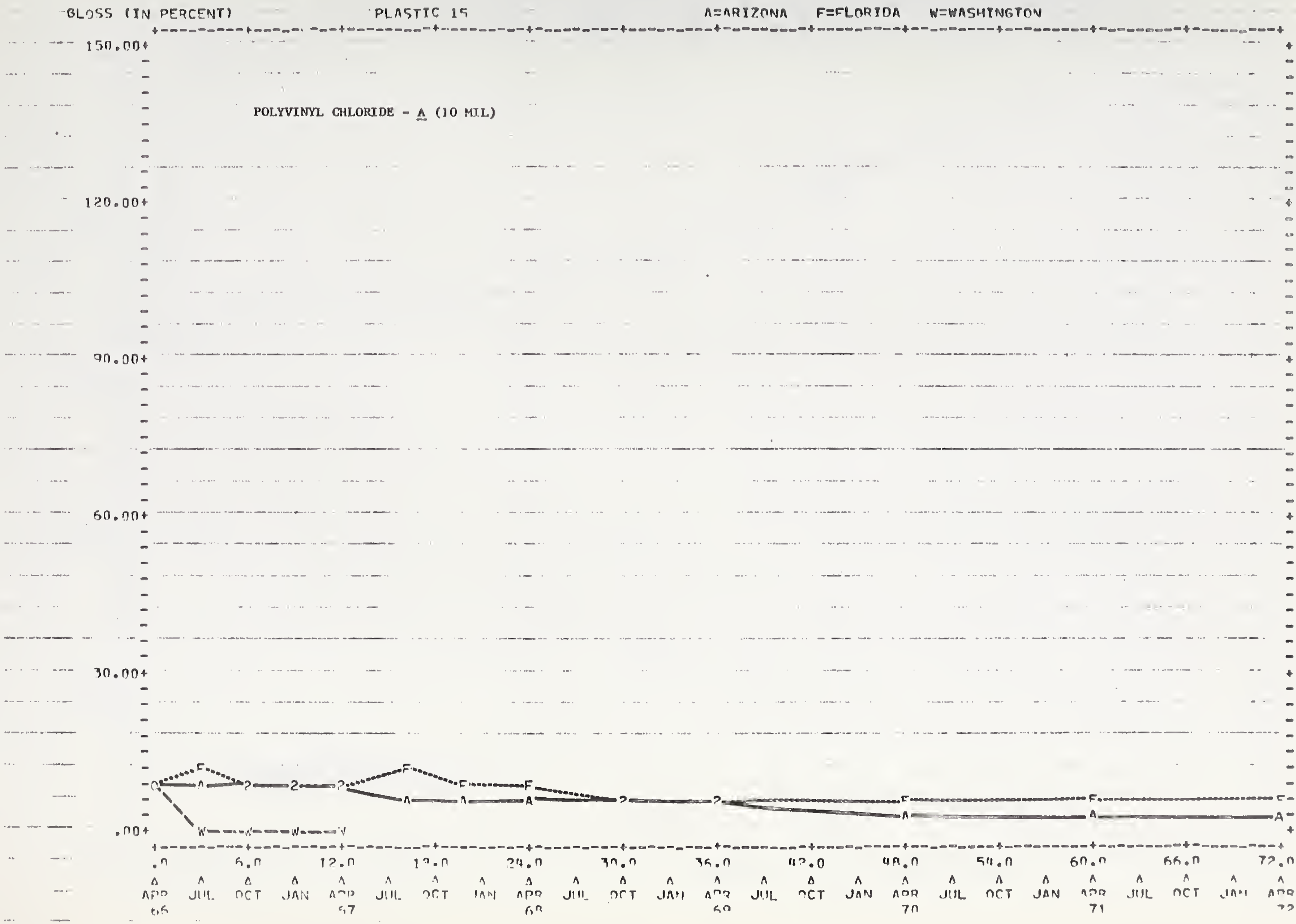

GLOSS (IN PERCENT)
PLASTIC 15
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - A (10 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
W
2

FIGURE 64

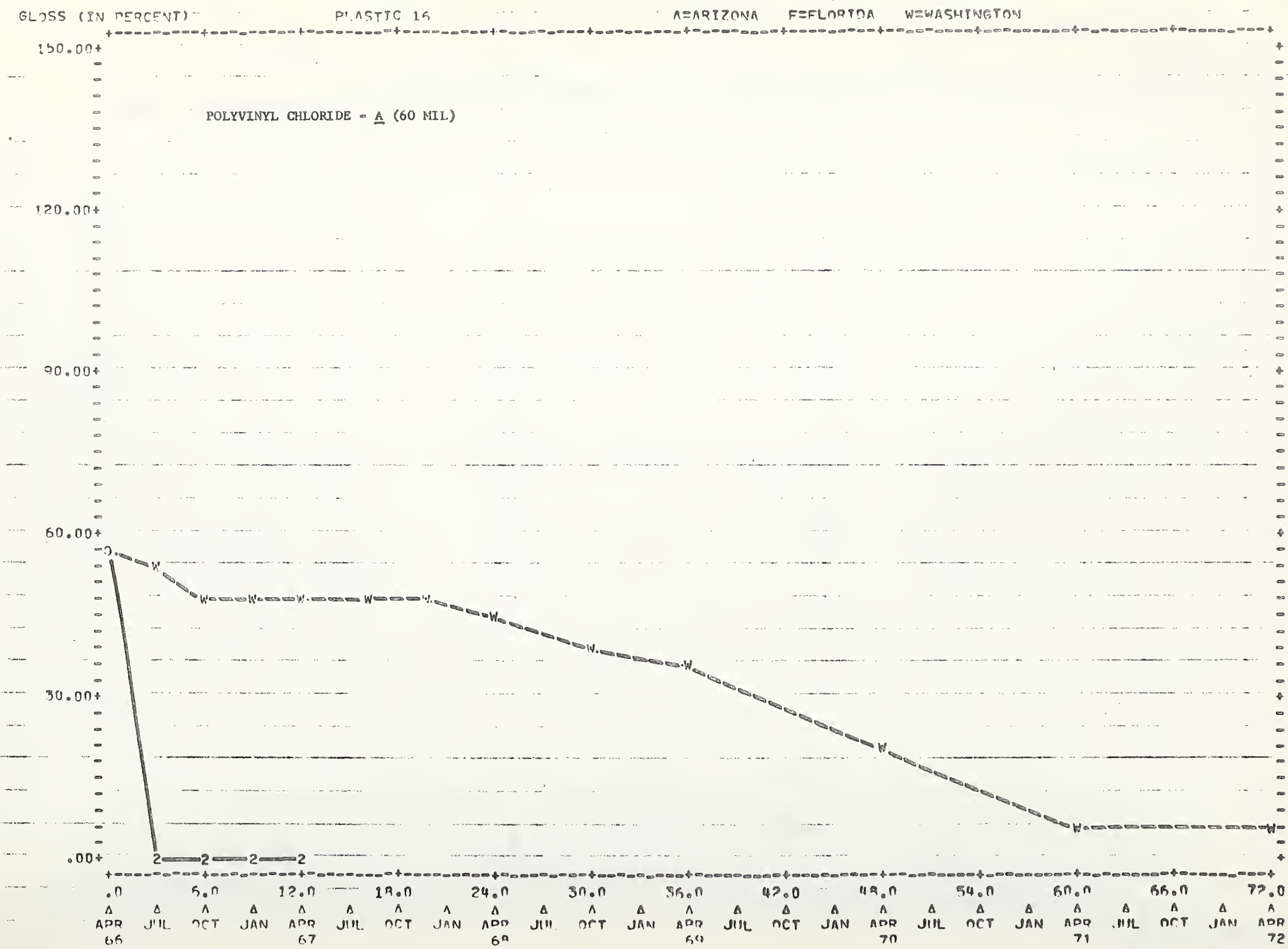
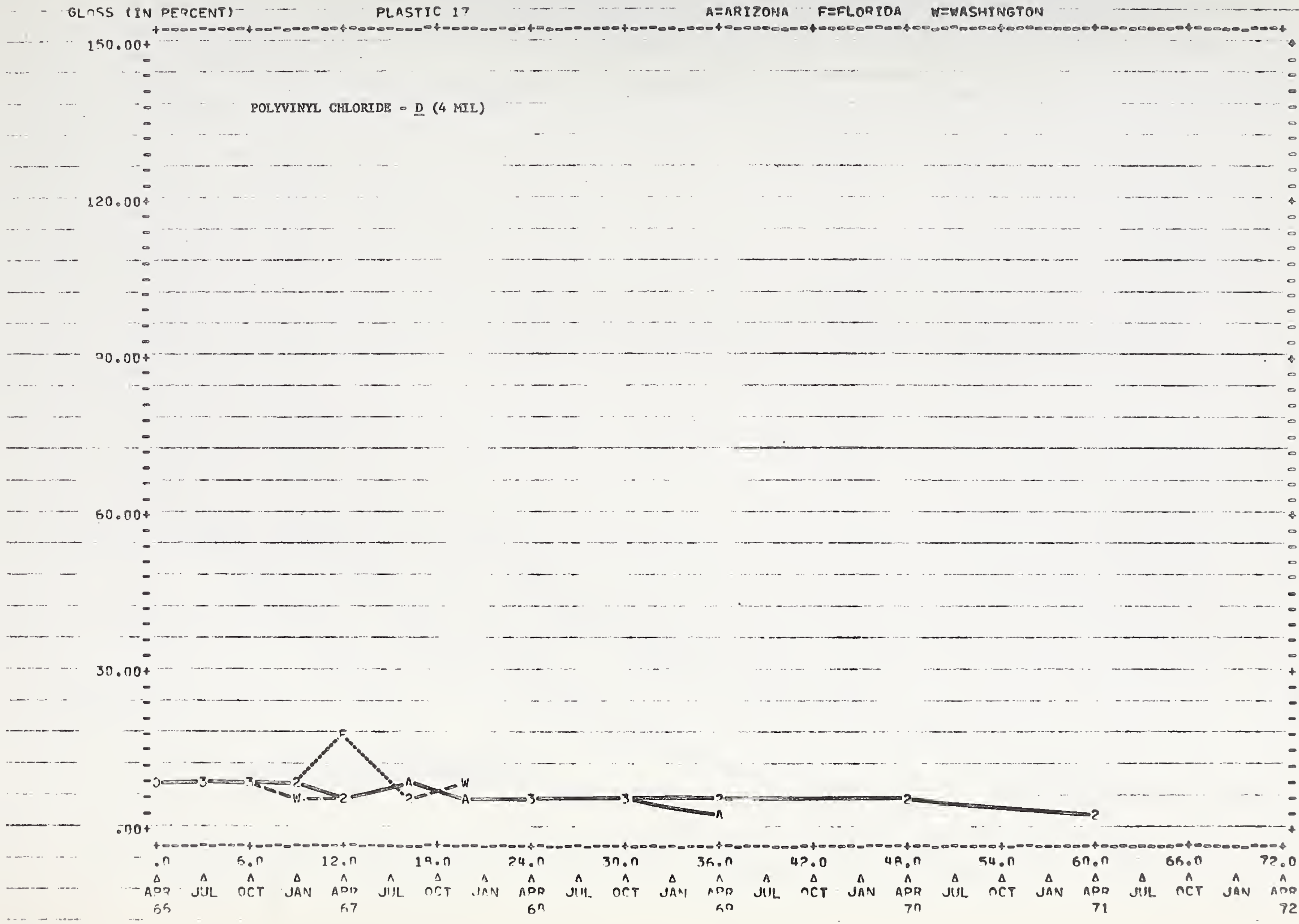

GLOSS (IN PERCENT)
PLASTIC 16
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - A (60 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
0
W
2

FIGURE 65


GLOSS (IN PERCENT)
PLASTIC 17
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - D (4 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

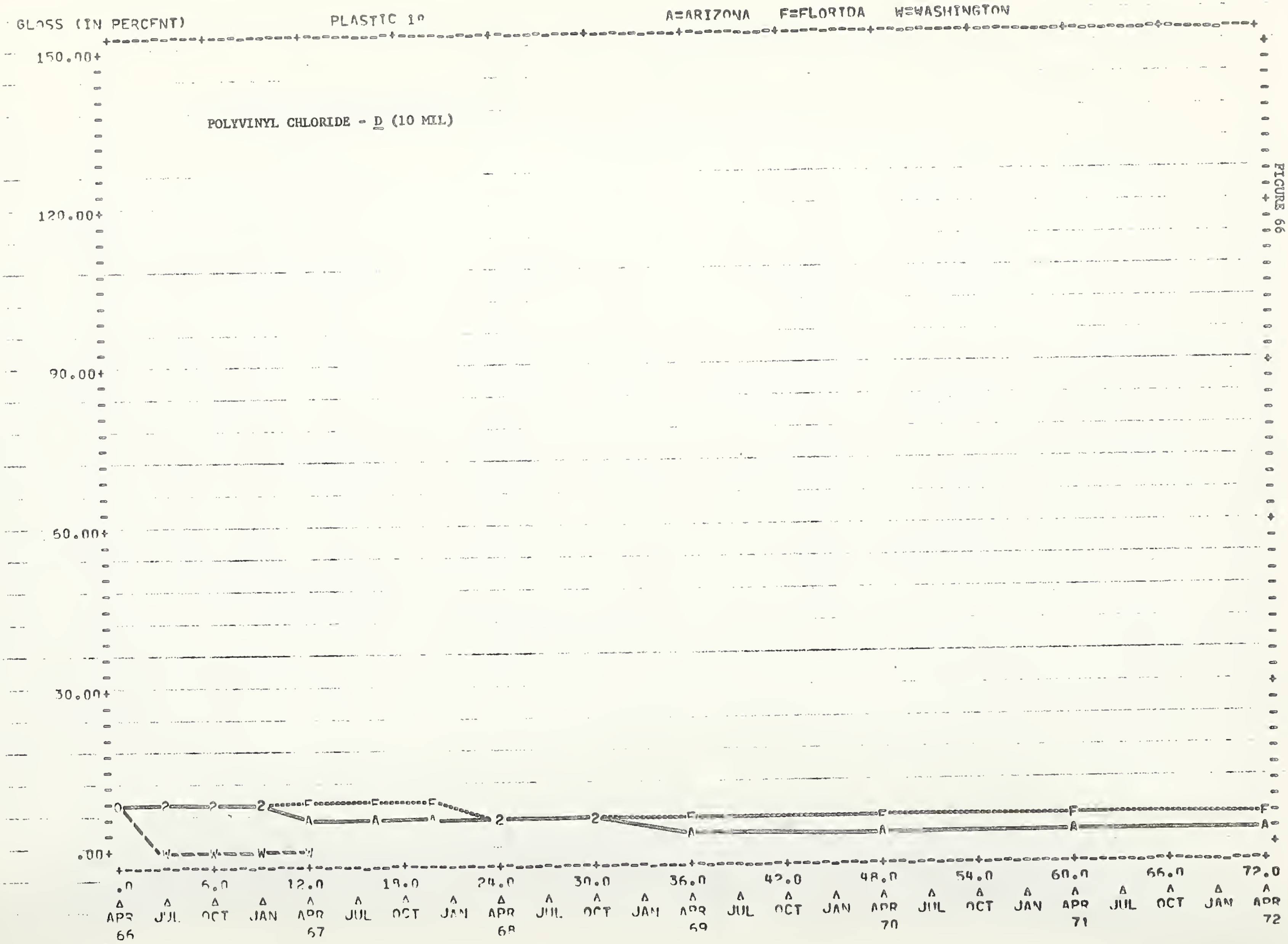

GLOSS (IN PERCENT)
PLASTIC 19
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - D (10 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 66

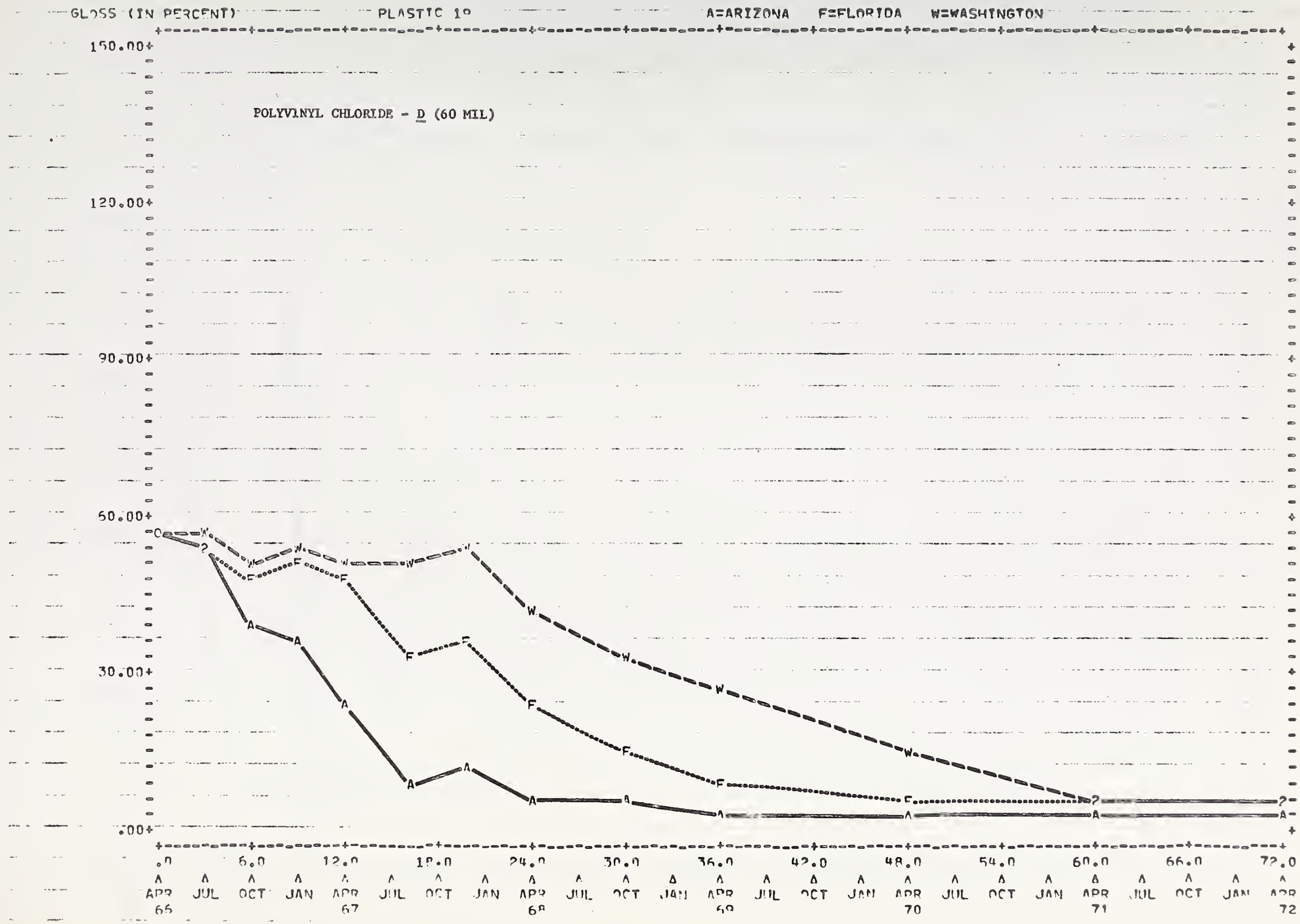

GLOSS (IN PERCENT)
PLASTIC 19
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - D (60 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 65
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 67

FIGURE 68

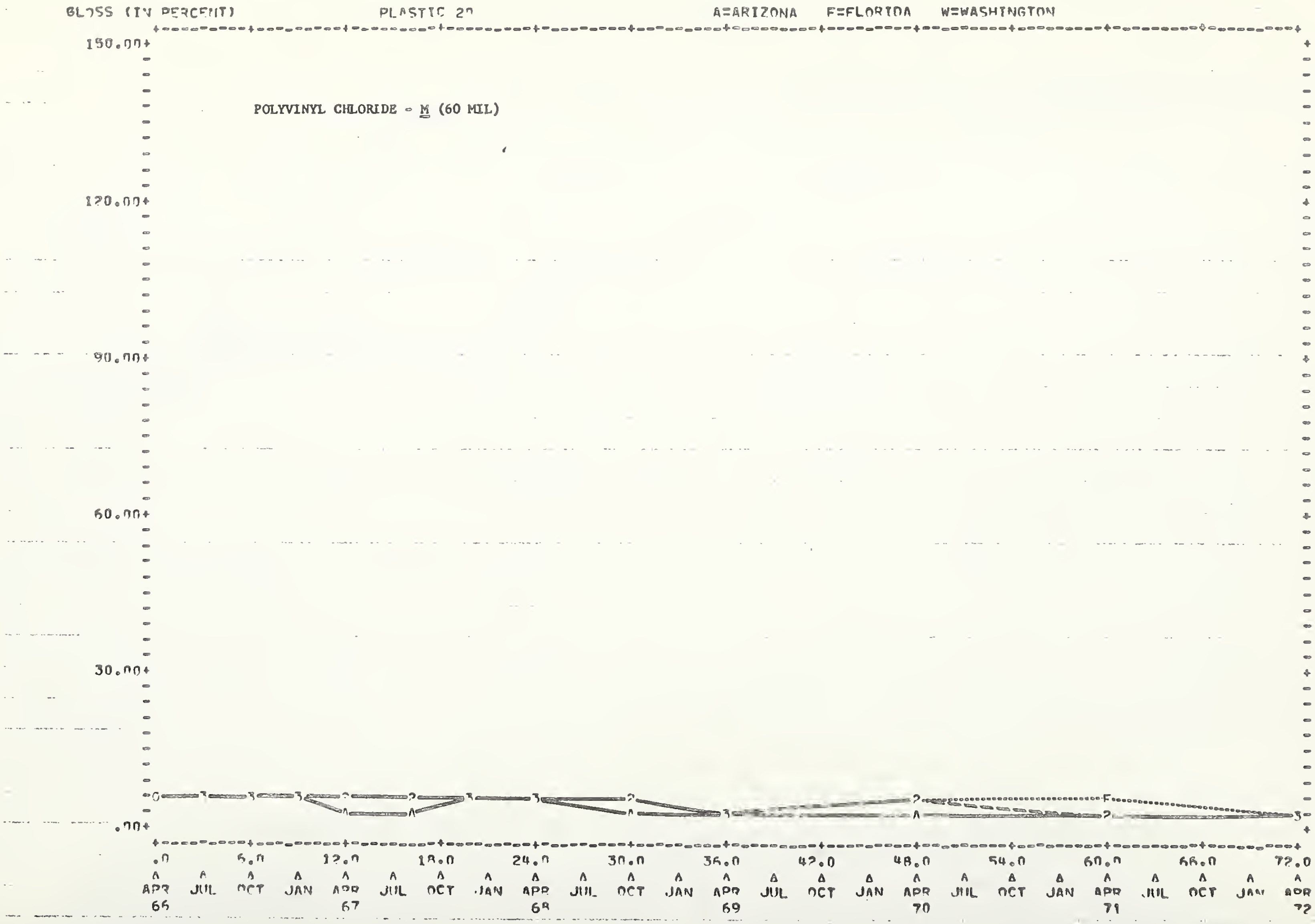

GLOSS (IN PERCENT)
PLASTIC 20
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - M (60 MIL)
150.00
120.00
90.00
60.00
30.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 69A

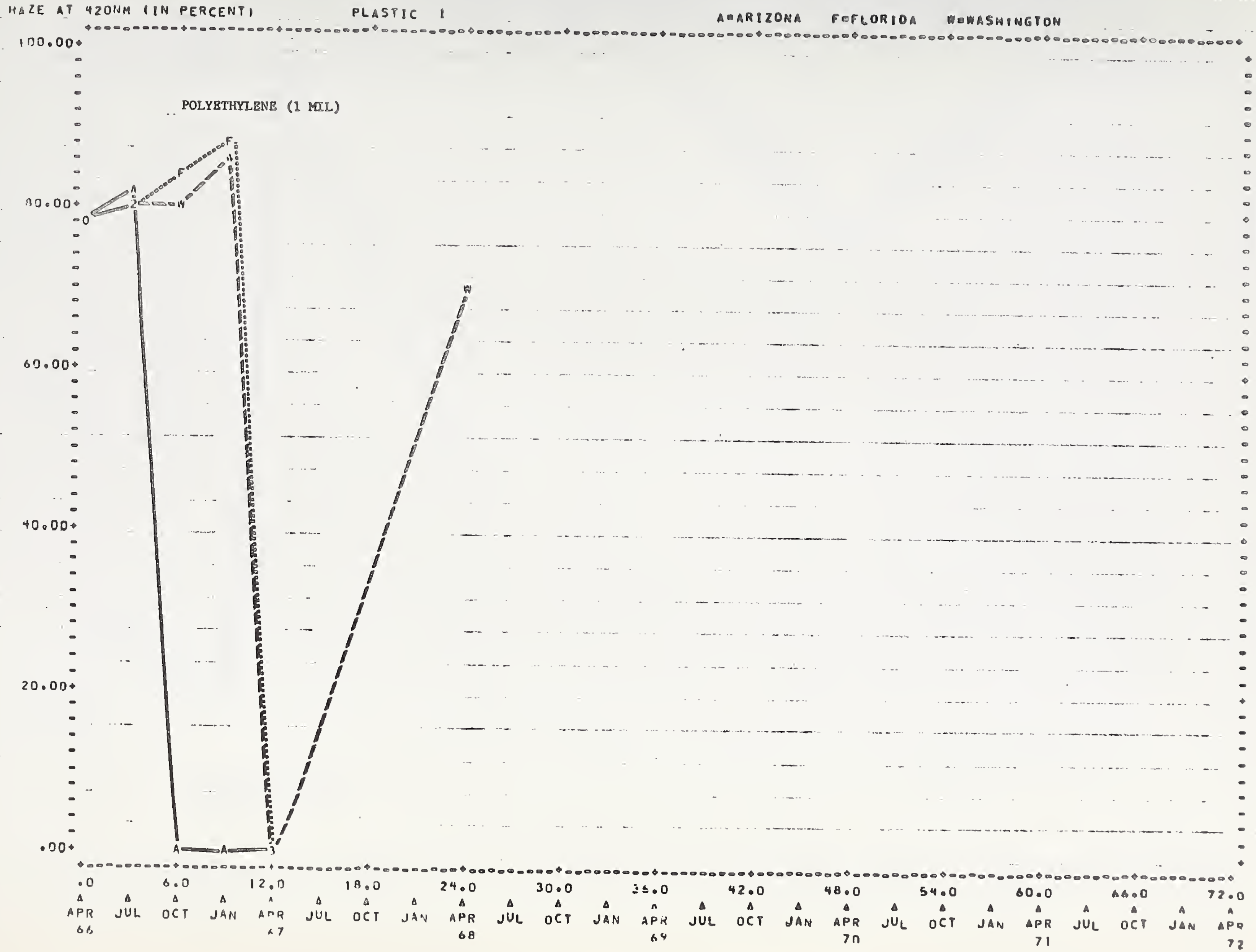

HAZE AT 420NM (IN PERCENT)
PLASTIC 1
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYETHYLENE (1 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 69B

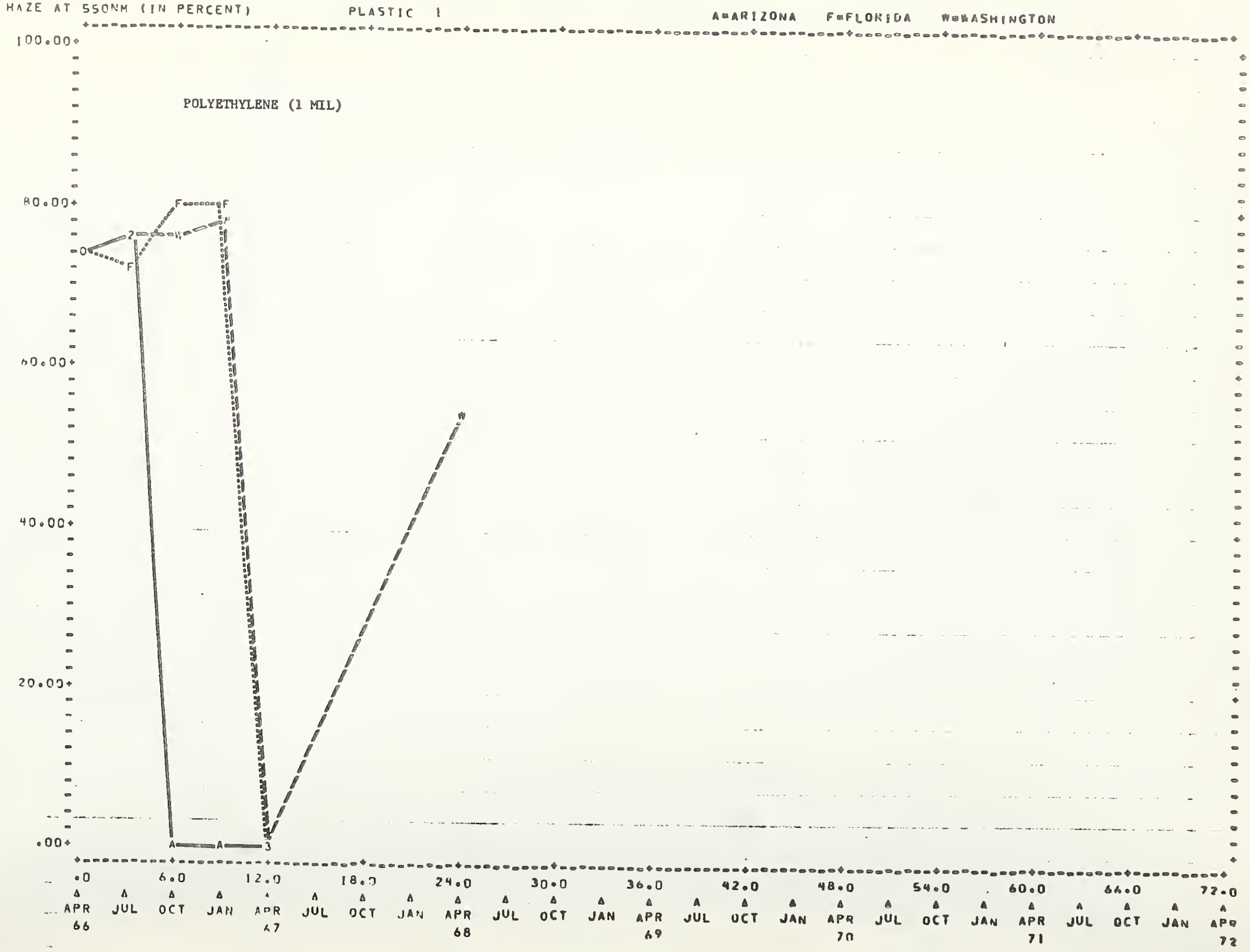

HAZE AT 550NM (IN PERCENT)
PLASTIC 1
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYETHYLENE (1 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
0
2
F
F
F
W
W
A
A
3
W

FIGURE 70A

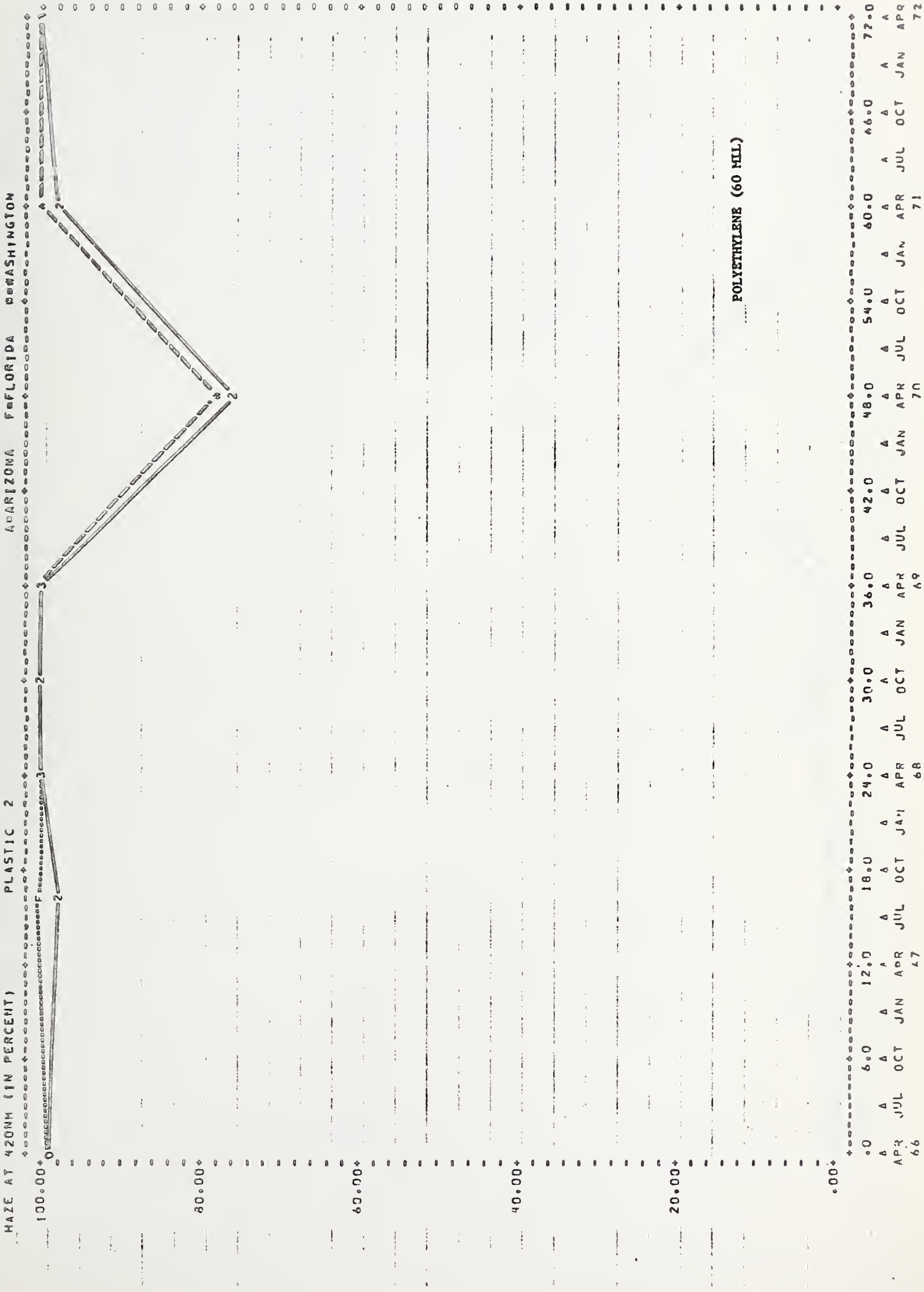

HAZE AT 420NM (IN PERCENT)
PLASTIC 2
A=ARIZONA F=FLORIDA O=WASHINGTON
POLYETHYLENE (60 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 70B

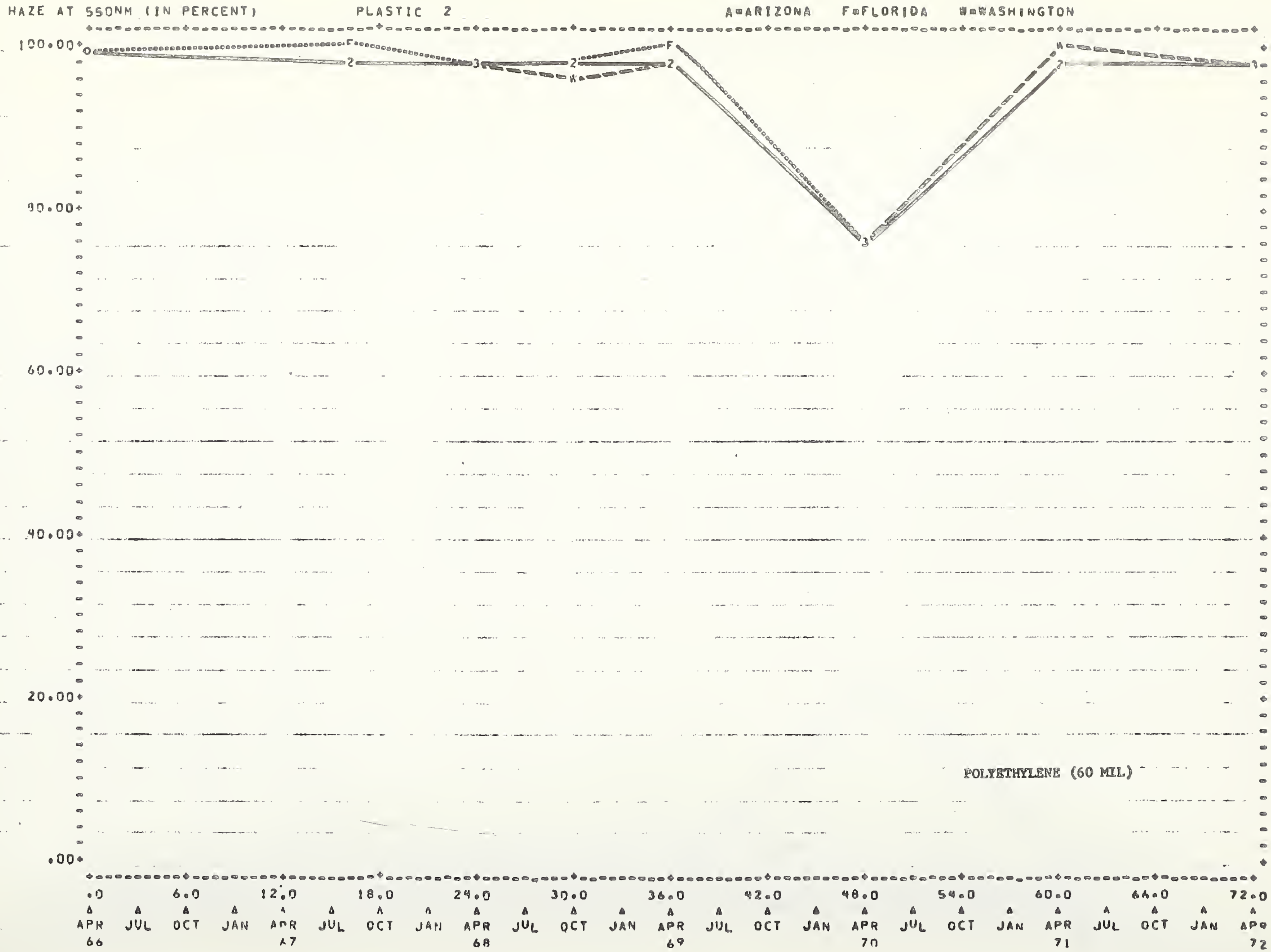

HAZE AT 550NM (IN PERCENT)
PLASTIC 2
A=ARIZONA F=FLORIDA W=WASHINGTON
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
POLYETHYLENE (60 MIL)

FIGURE 71A

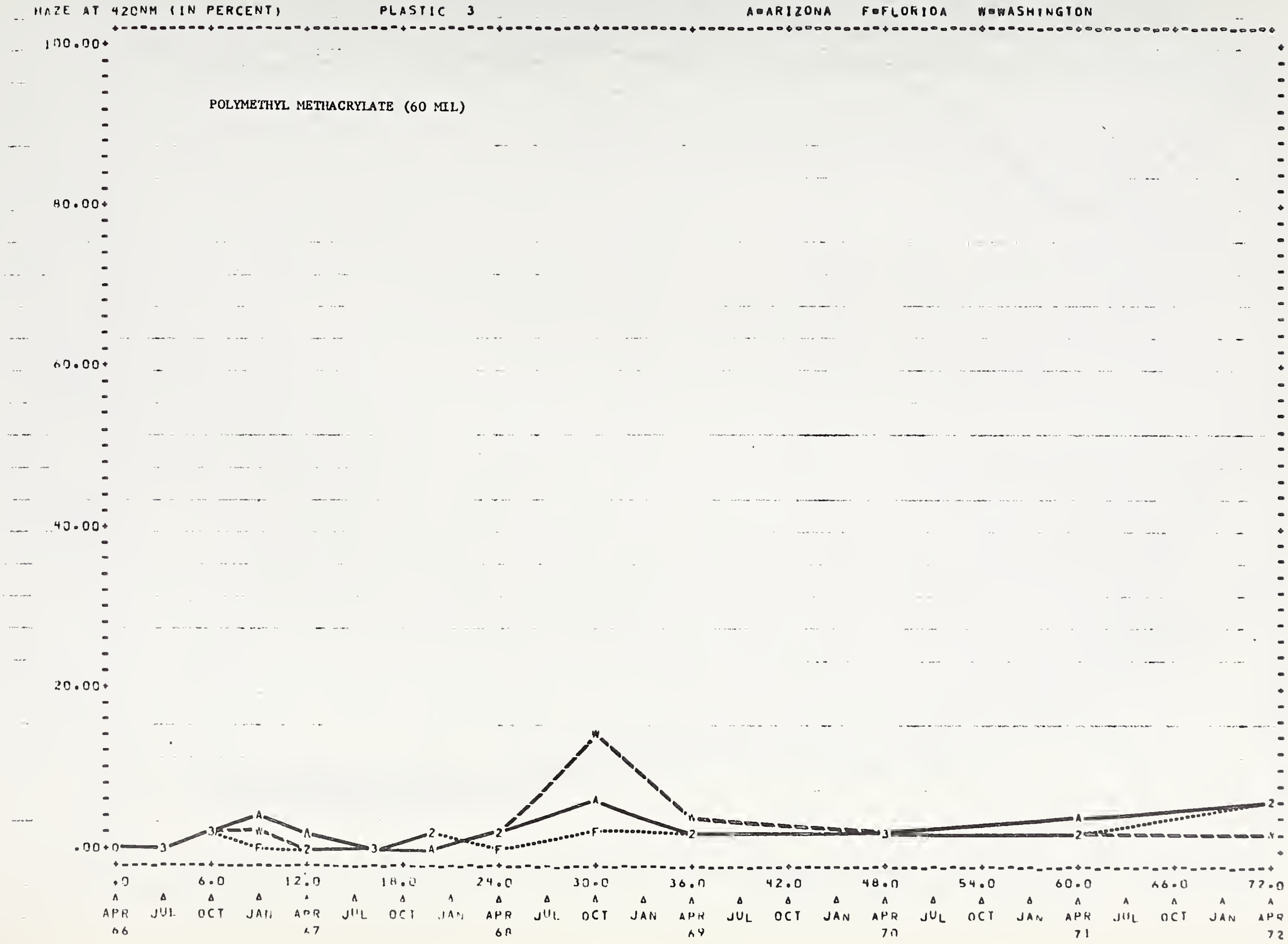

HAZE AT 420NM (IN PERCENT)
PLASTIC 3
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYMETHYL METHACRYLATE (60 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 71B

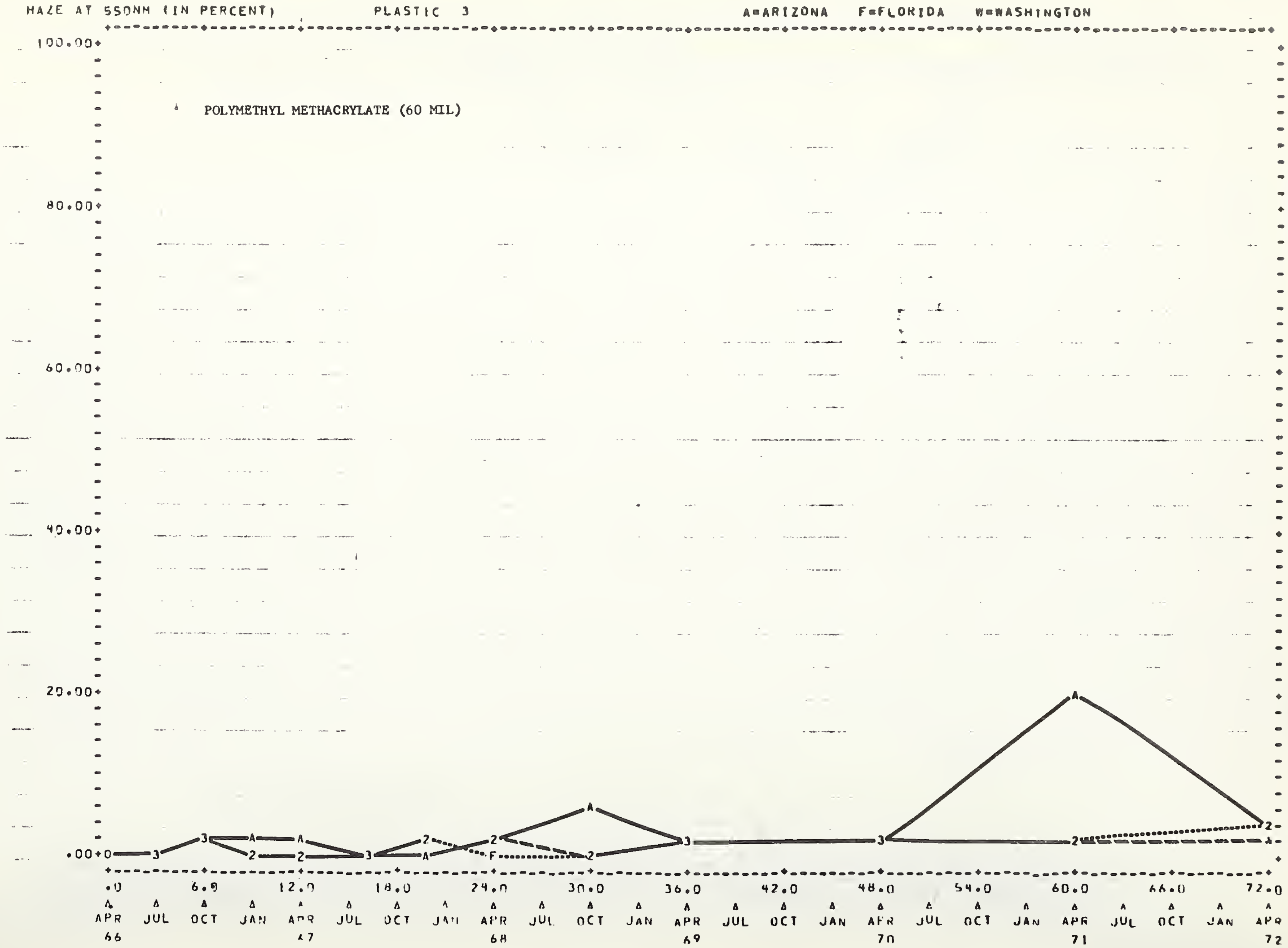

HAZE AT 550NM (IN PERCENT)
PLASTIC 3
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYMETHYL METHACRYLATE (60 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 72A

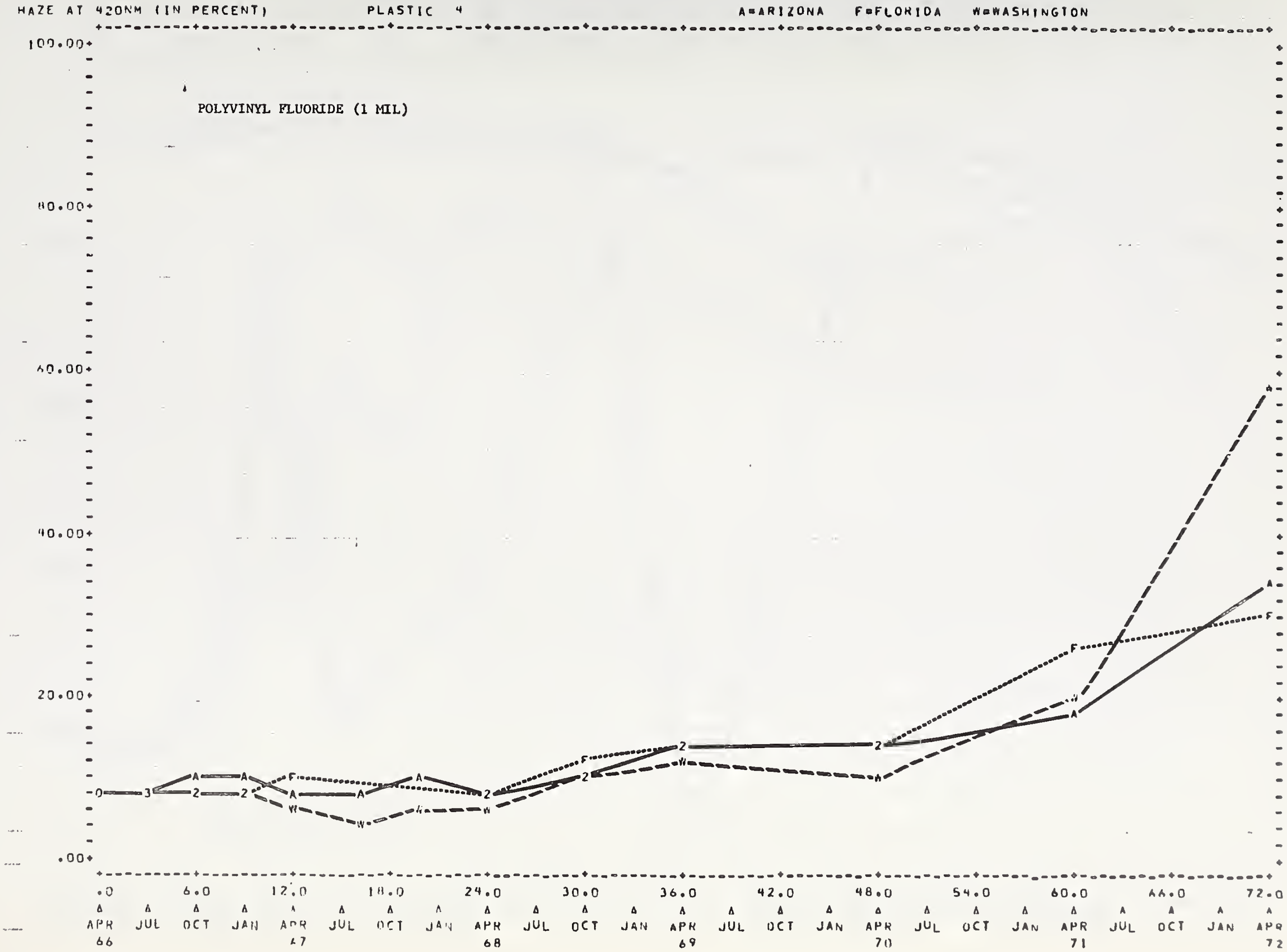

HAZE AT 420NM (IN PERCENT)
PLASTIC 4
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL FLUORIDE (1 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 72B

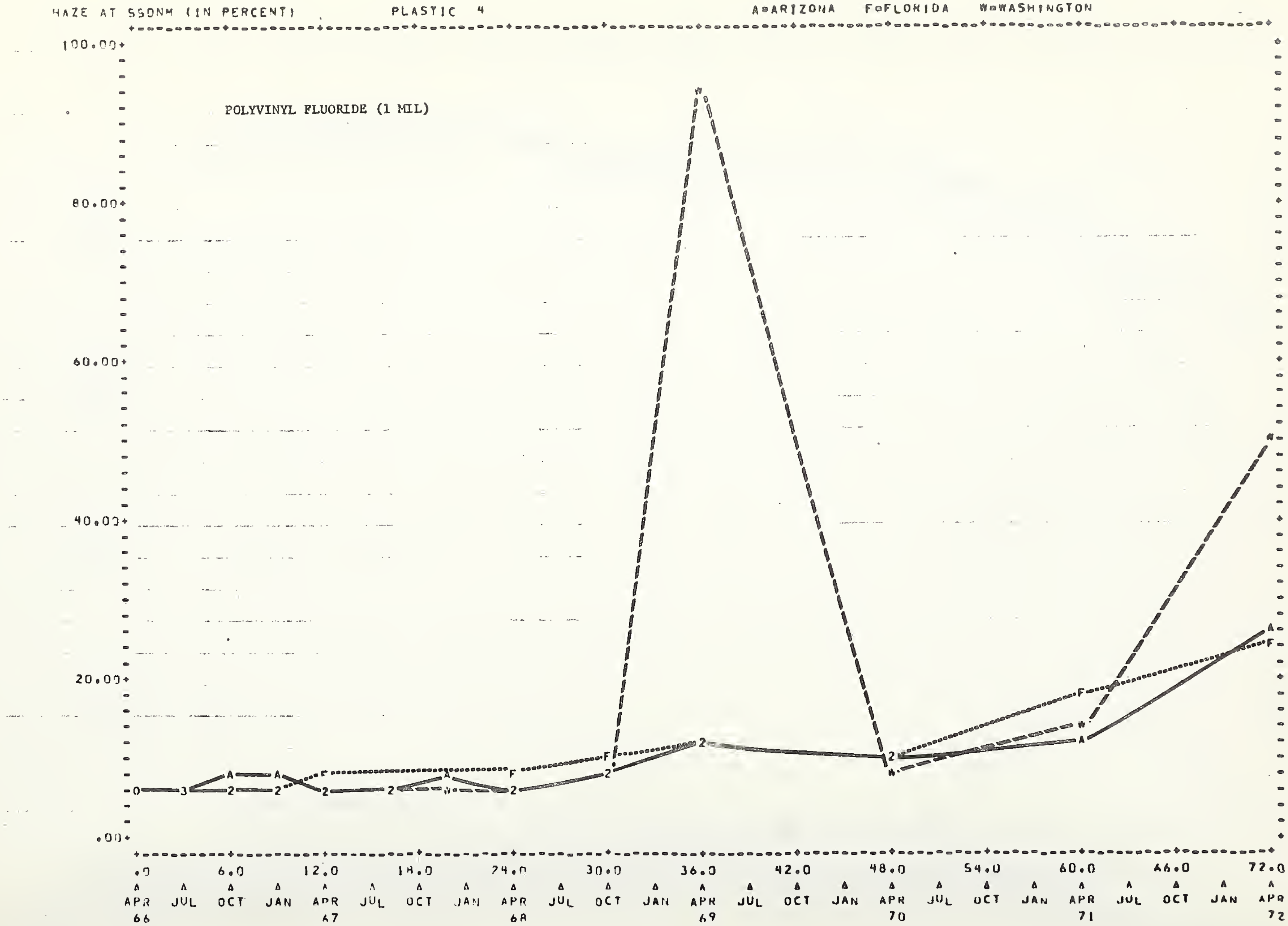

HAZE AT 550NM (IN PERCENT)
PLASTIC 4
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL FLUORIDE (1 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 73A

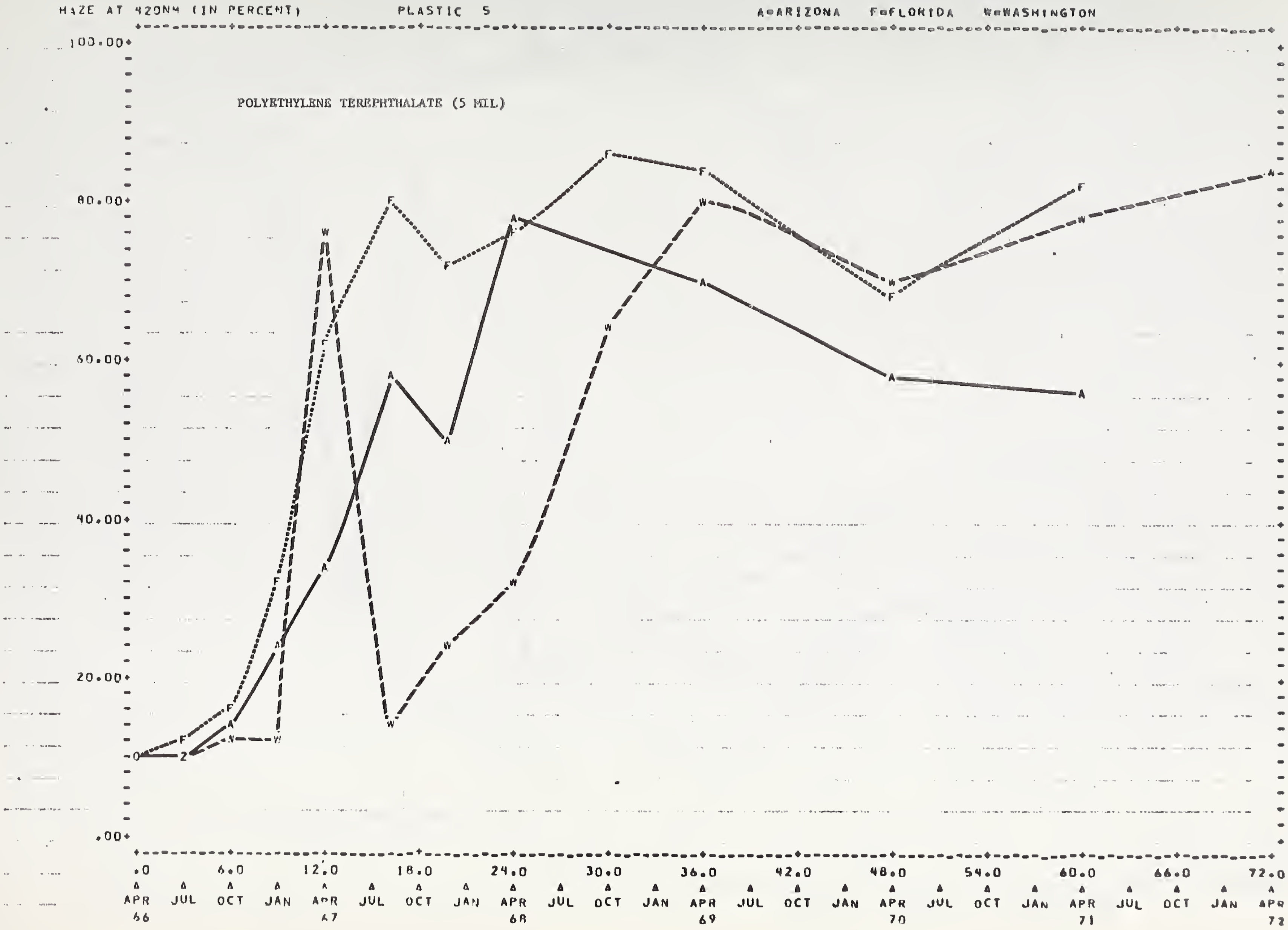

HAZE AT 420NM (IN PERCENT)
PLASTIC 5
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYETHYLENE TEREPHTHALATE (5 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 73B

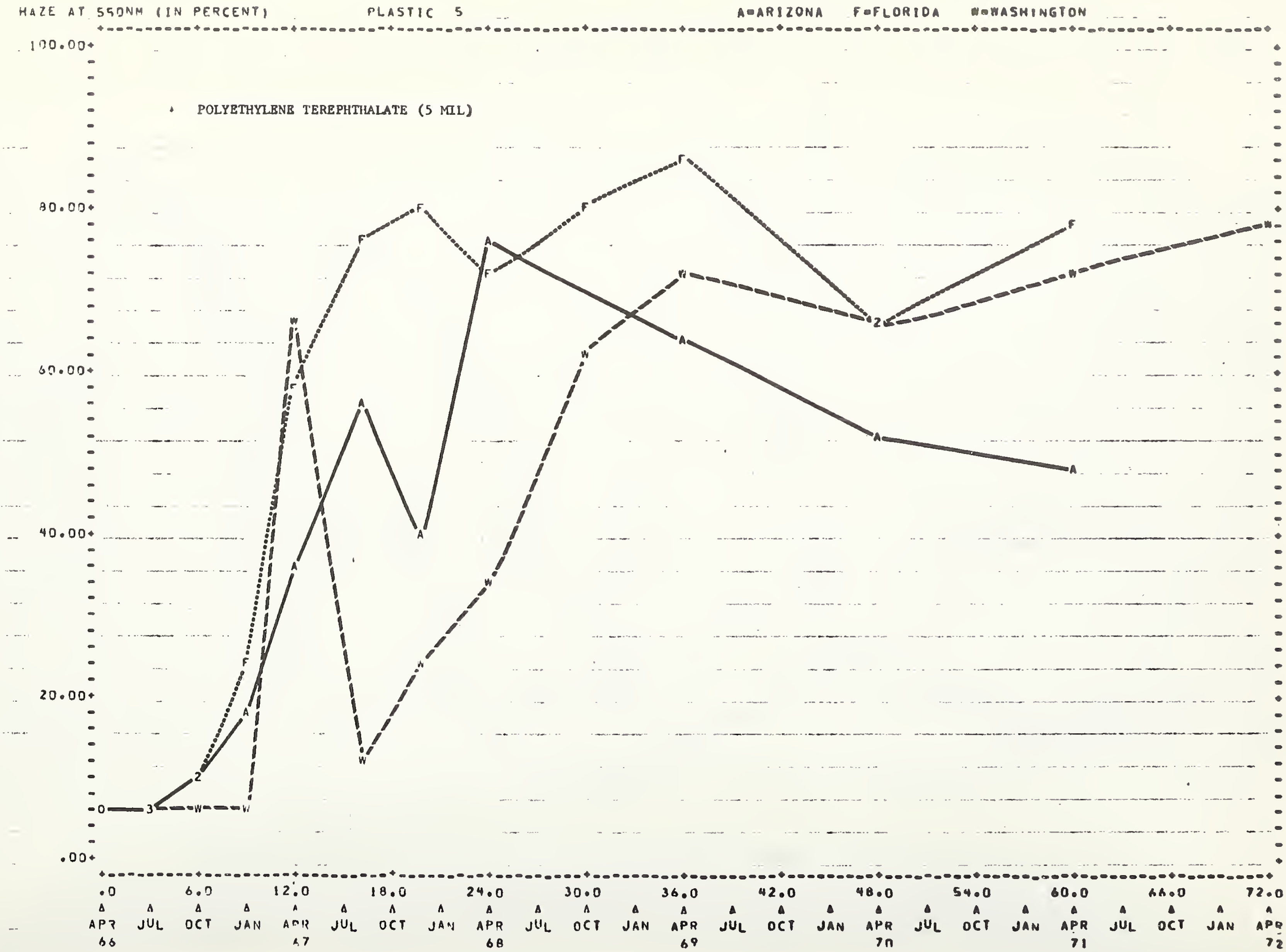
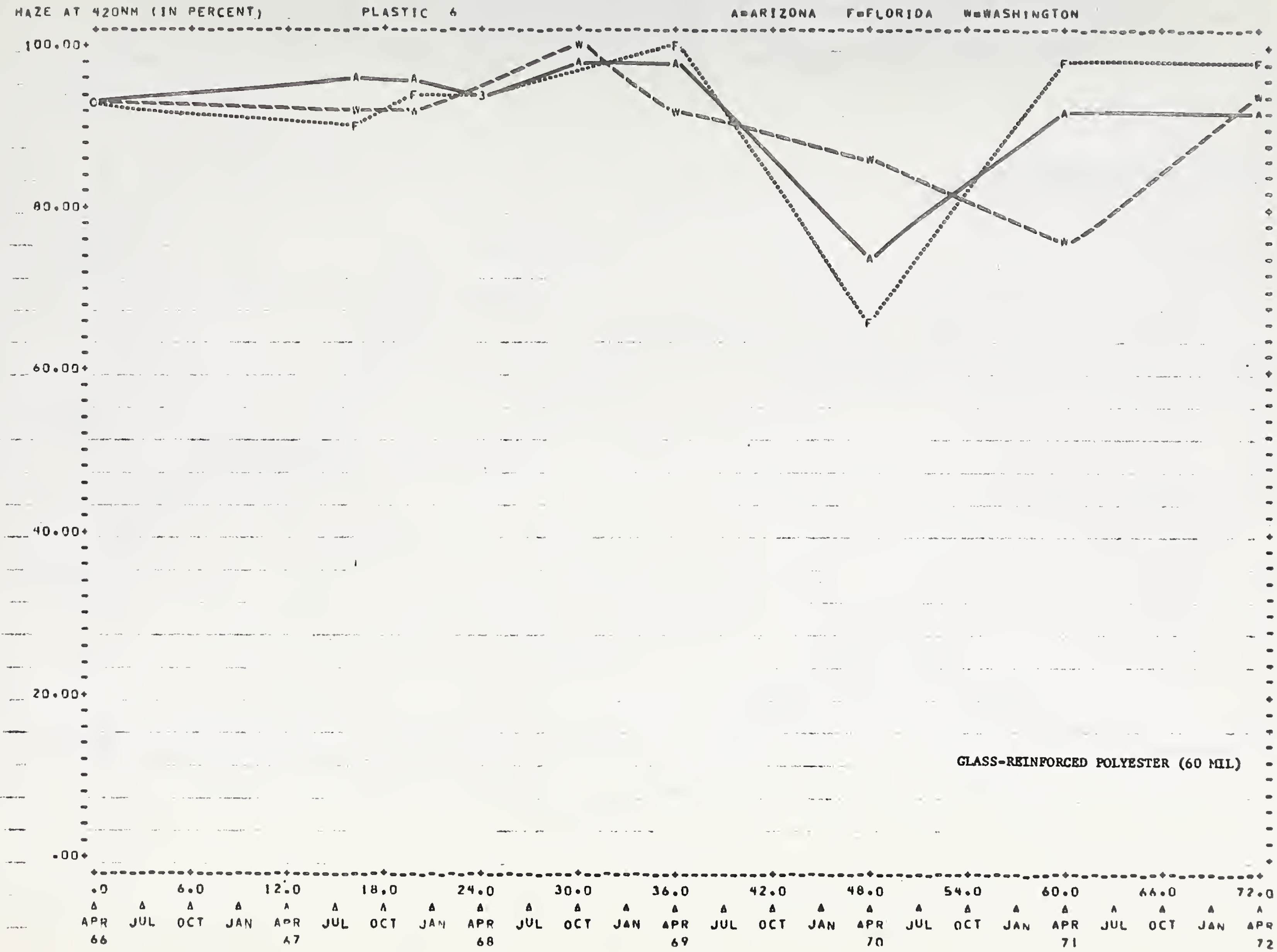

HAZE AT 550NM (IN PERCENT)
PLASTIC 5
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYETHYLENE TEREPHTHALATE (5 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 74A


HAZE AT 420NM (IN PERCENT)
PLASTIC 6
A=ARIZONA F=FLORIDA W=WASHINGTON
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
GLASS-REINFORCED POLYESTER (60 MIL)

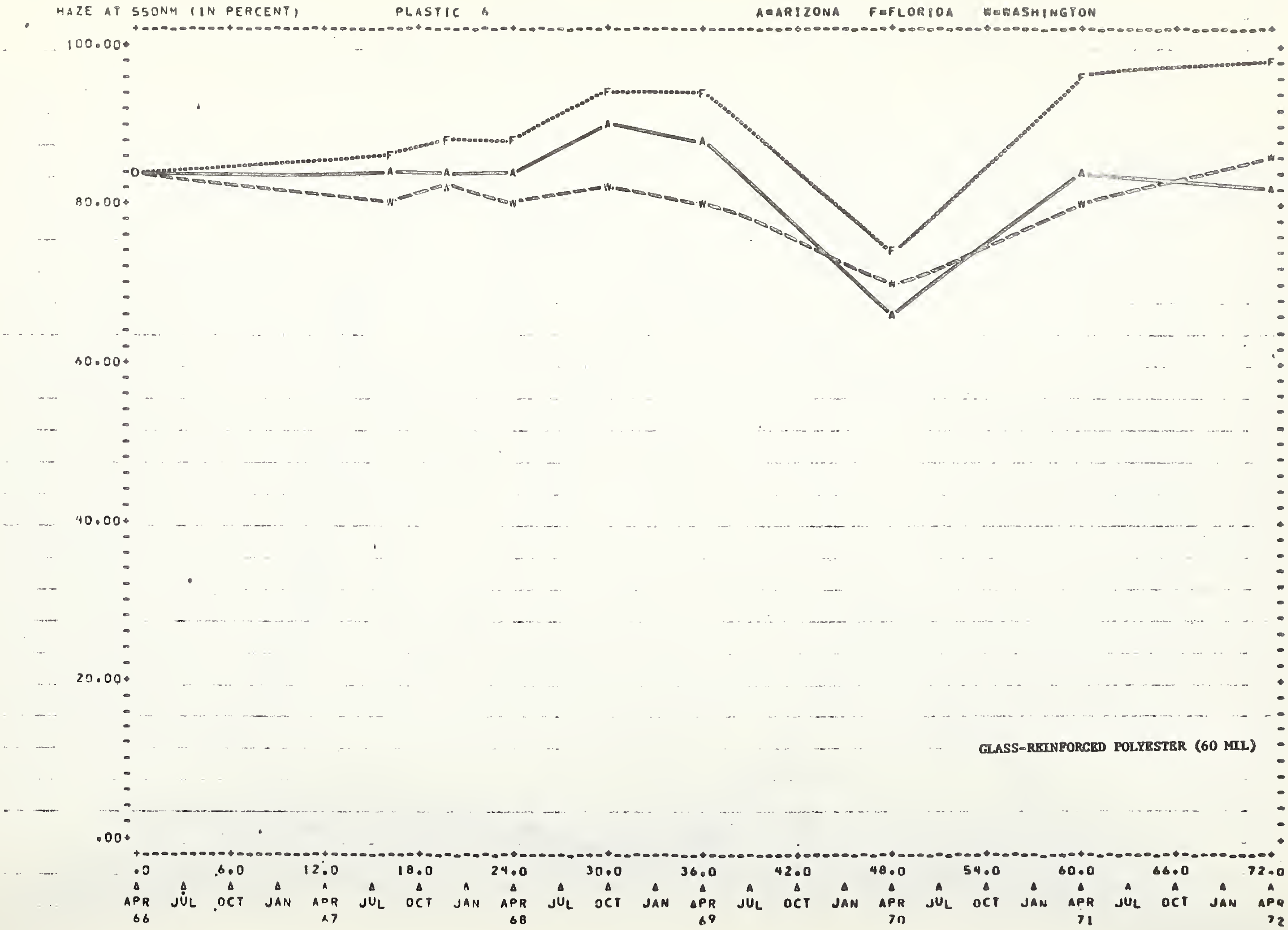

HAZE AT 550NM (IN PERCENT)
PLASTIC 6
A=ARIZONA F=FLORIDA W=WASHINGTON
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
GLASS-REINFORCED POLYESTER (60 MIL)

FIGURE 74B

FIGURE 75A

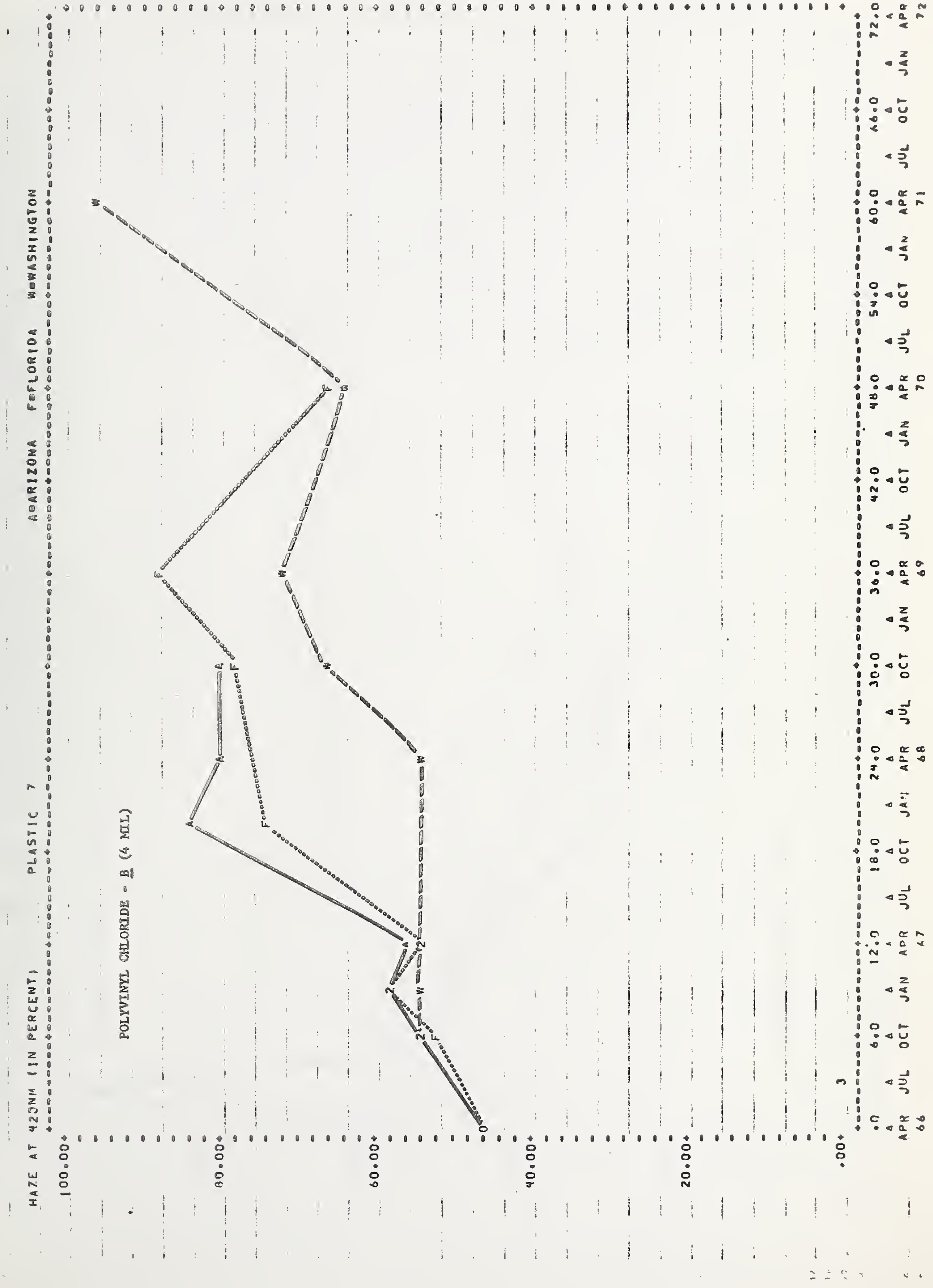

HAZE AT 420NM (IN PERCENT)
PLASTIC 7
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - B (4 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
3

FIGURE 75B

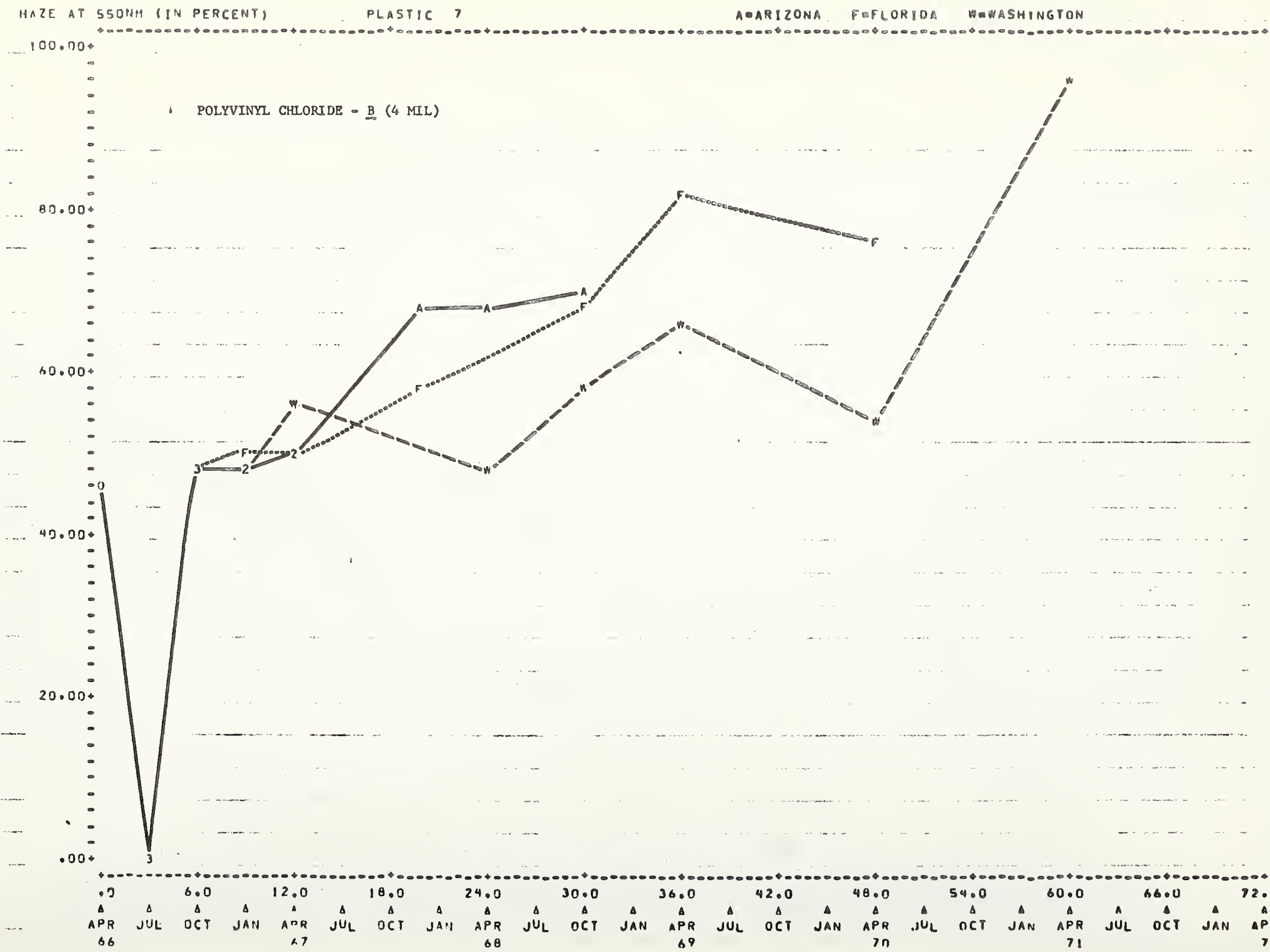

HAZE AT 550NM (IN PERCENT)
PLASTIC 7
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - B (4 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
0
3
3
2
2
F
W
A
A
A
F
F
F
F
W
W
W
W
W

FIGURE 76A

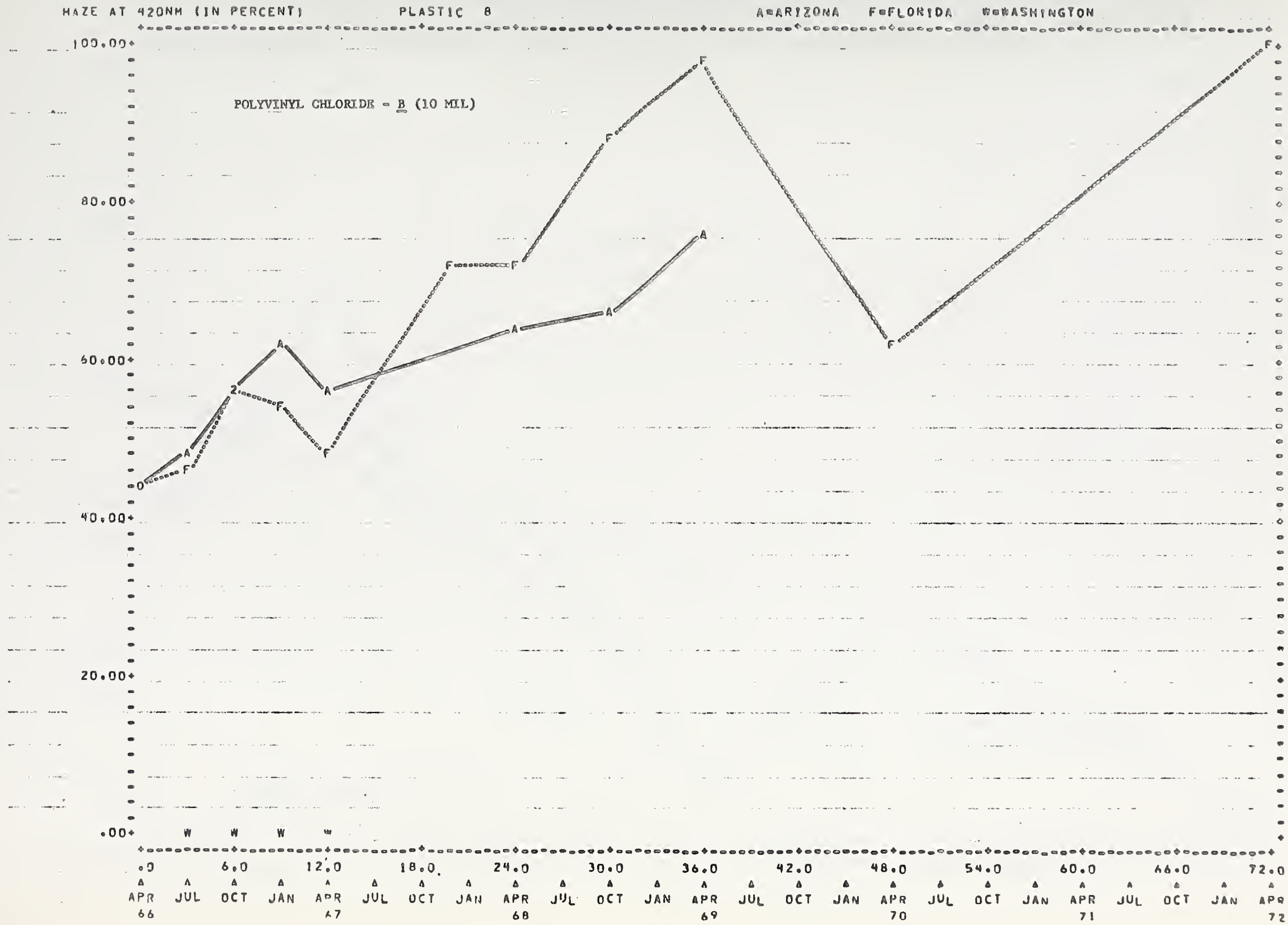
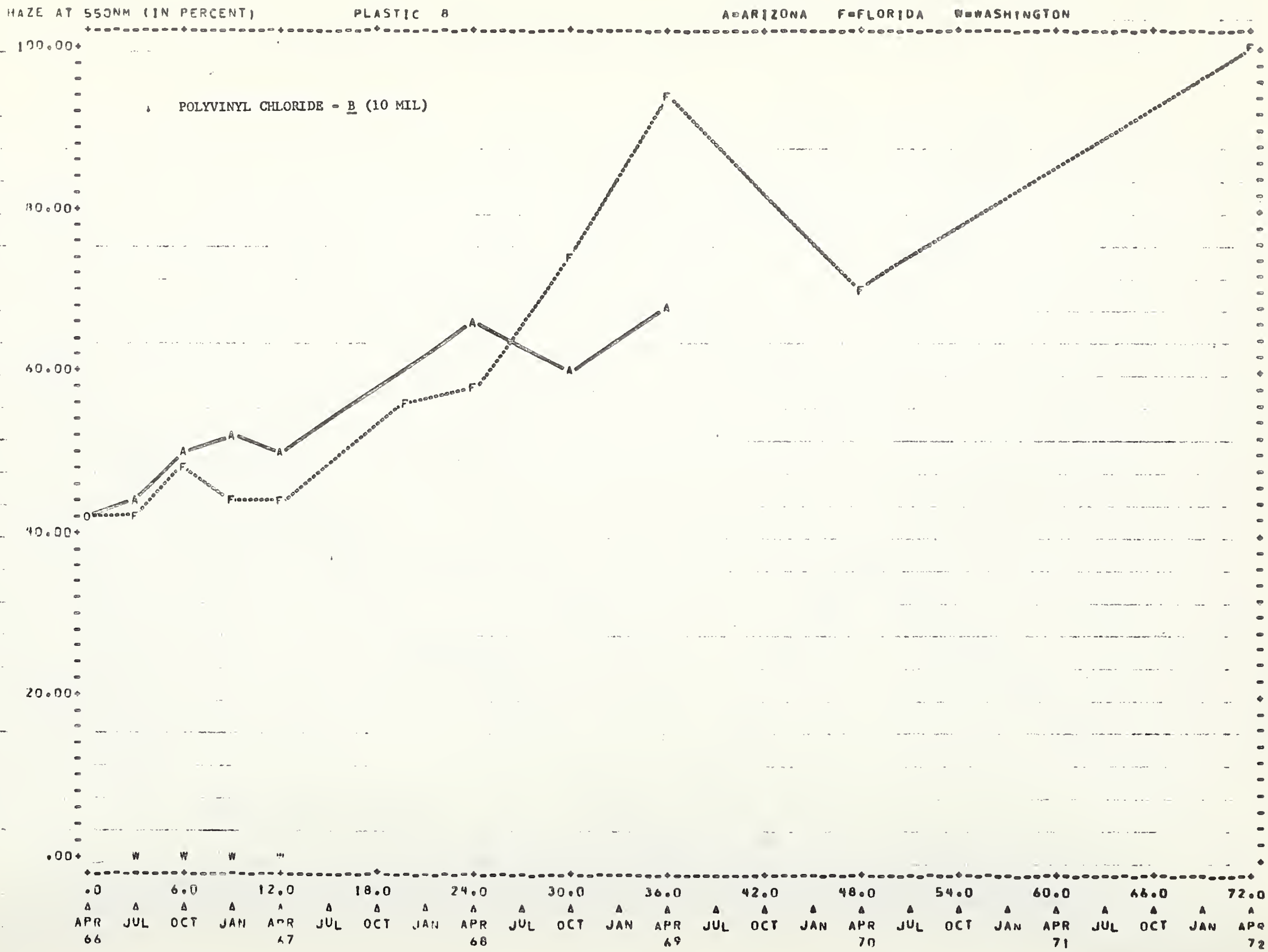
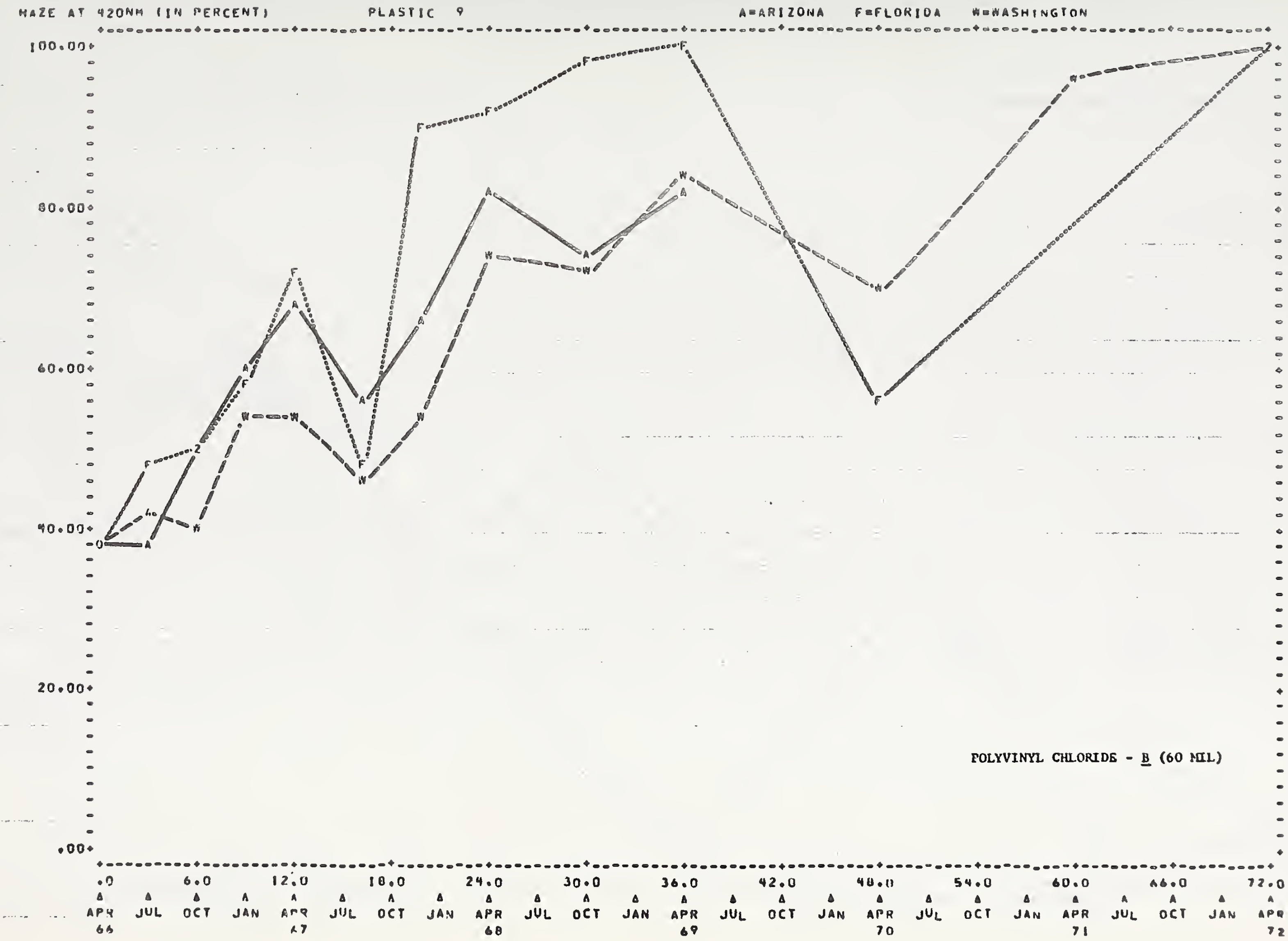

POLYVINYL CHLORIDE - B (10 MIL)

FIGURE 76B



POLYVINYL CHLORIDE - B (10 MIL)

FIGURE 77A


HAZE AT 420NM (IN PERCENT)
PLASTIC 9
A=ARIZONA F=FLORIDA W=WASHINGTON
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
W
POLYVINYL CHLORIDES - B (60 MIL)

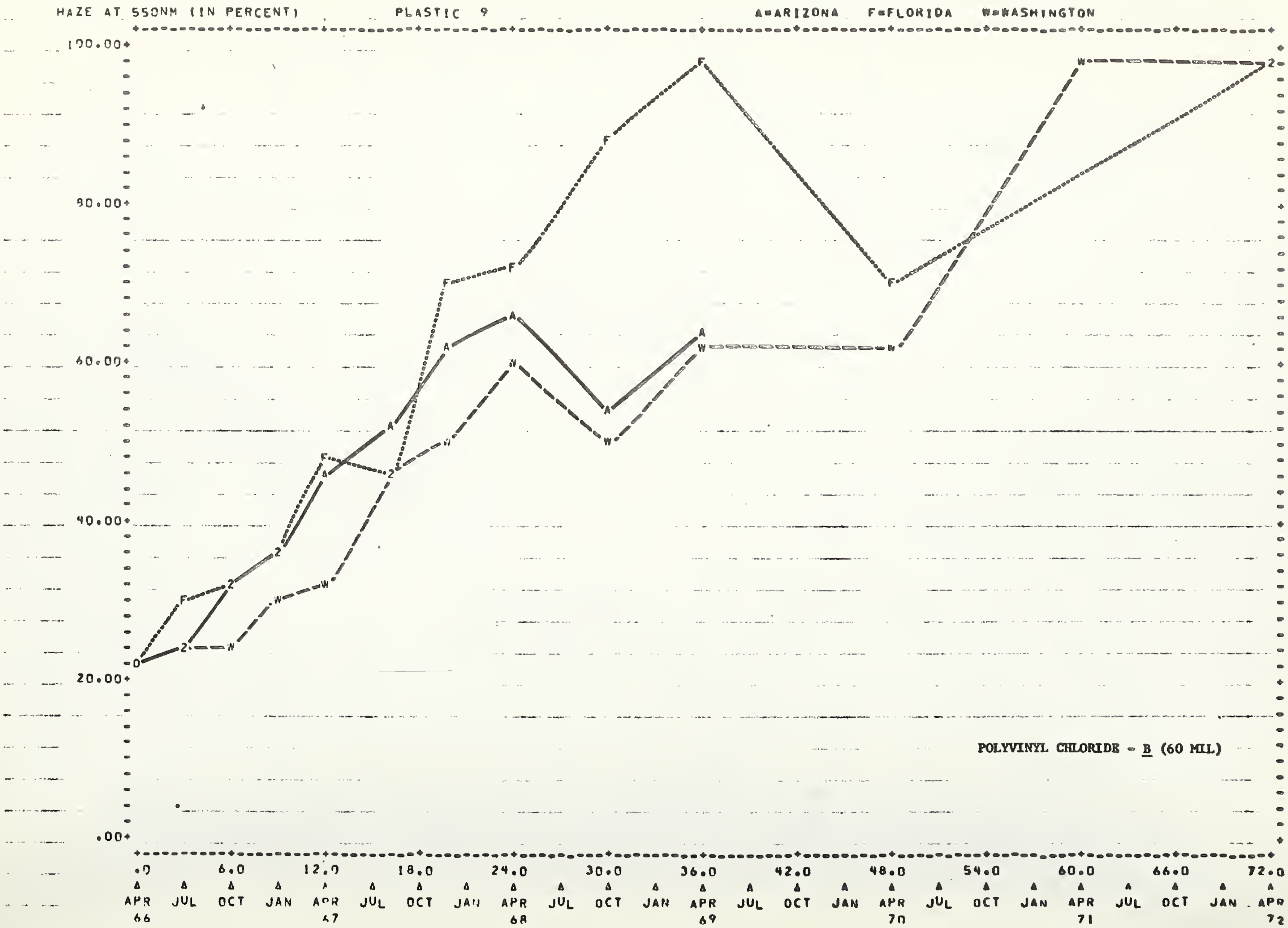

HAZE AT 550NM (IN PERCENT)
PLASTIC 9
A=ARIZONA F=FLORIDA W=WASHINGTON
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
POLYVINYL CHLORIDE - B (60 MIL)

FIGURE 77B

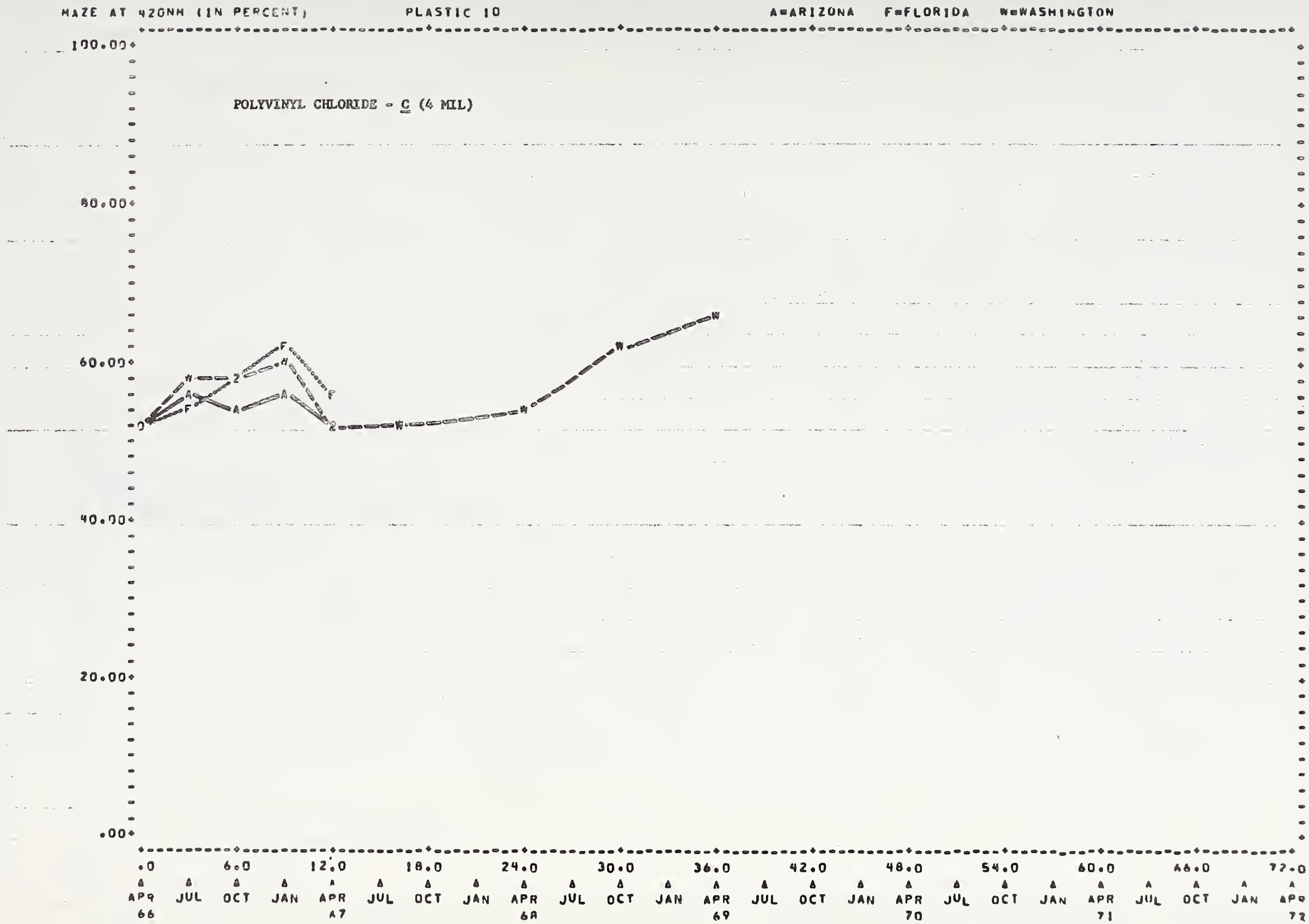

HAZE AT 420NM (IN PERCENT)
PLASTIC 10
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - C (4 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 78A

FIGURE 78B

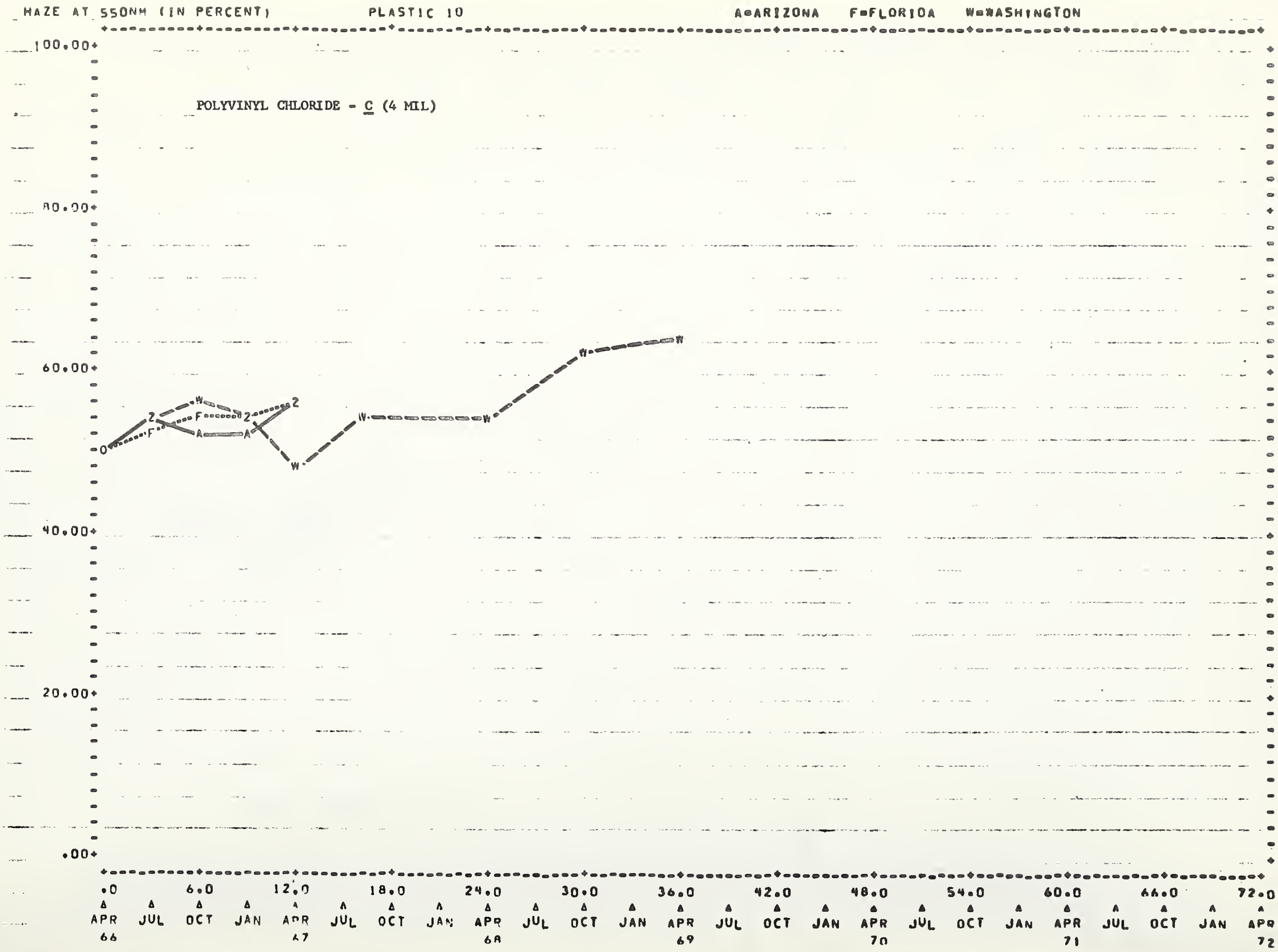

HAZE AT 550NM (IN PERCENT)
PLASTIC 10
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - C (4 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
O
A
F
W
2

FIGURE 79A

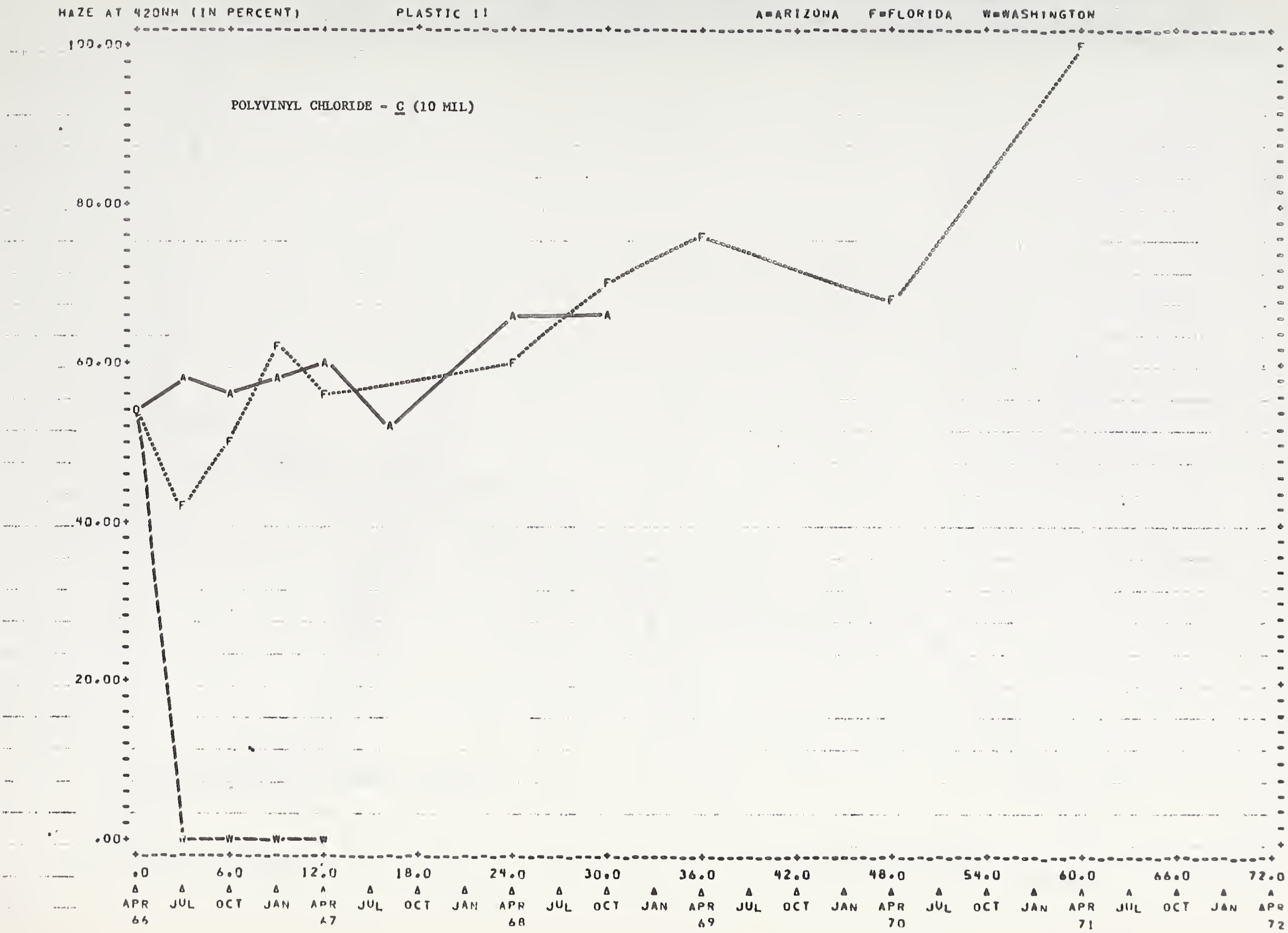

HAZE AT 420NM (IN PERCENT)
PLASTIC 11
A=ARIZONA
F=FLORIDA
W=WASHINGTON
POLYVINYL CHLORIDE - C (10 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 79B

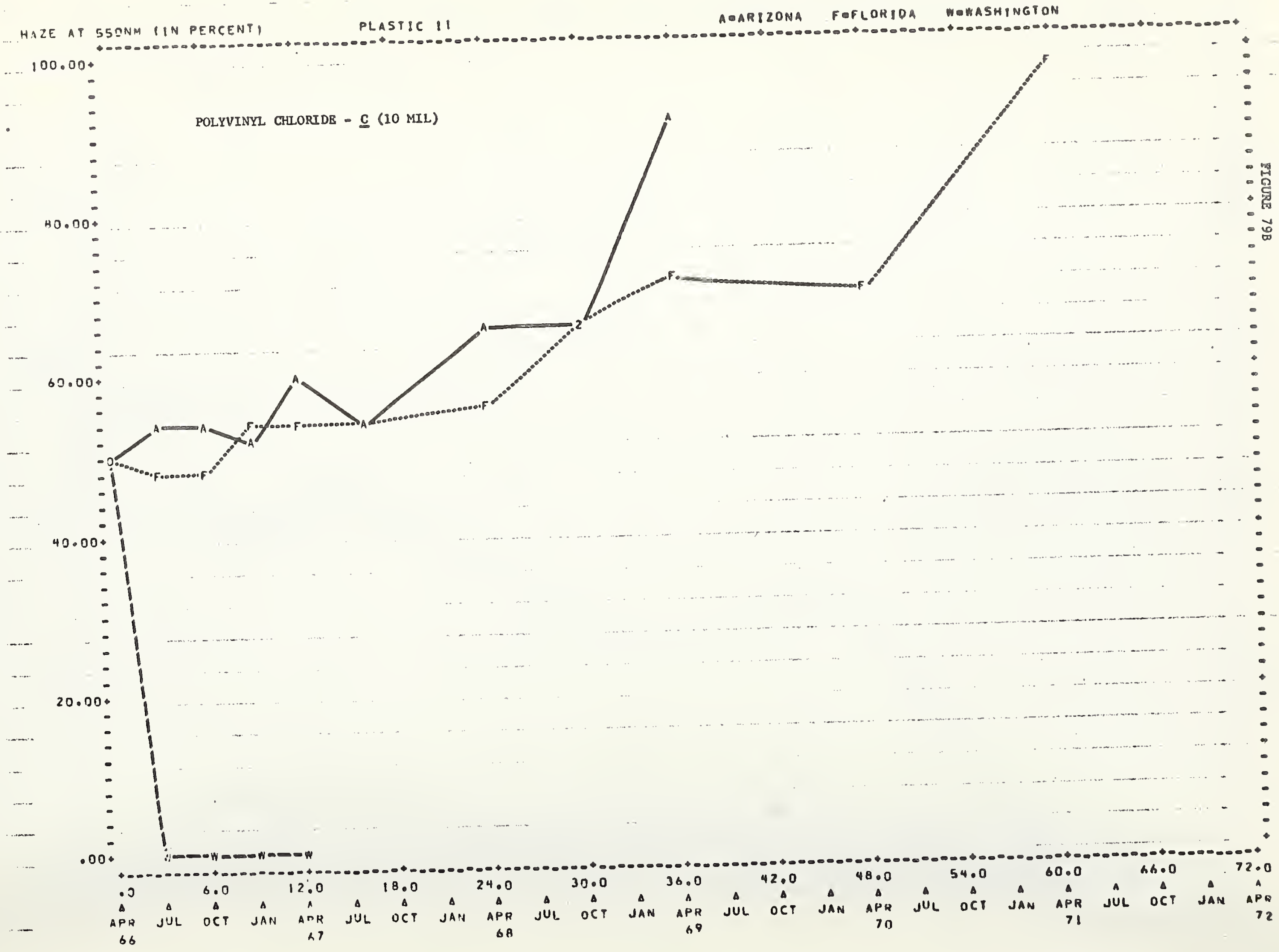
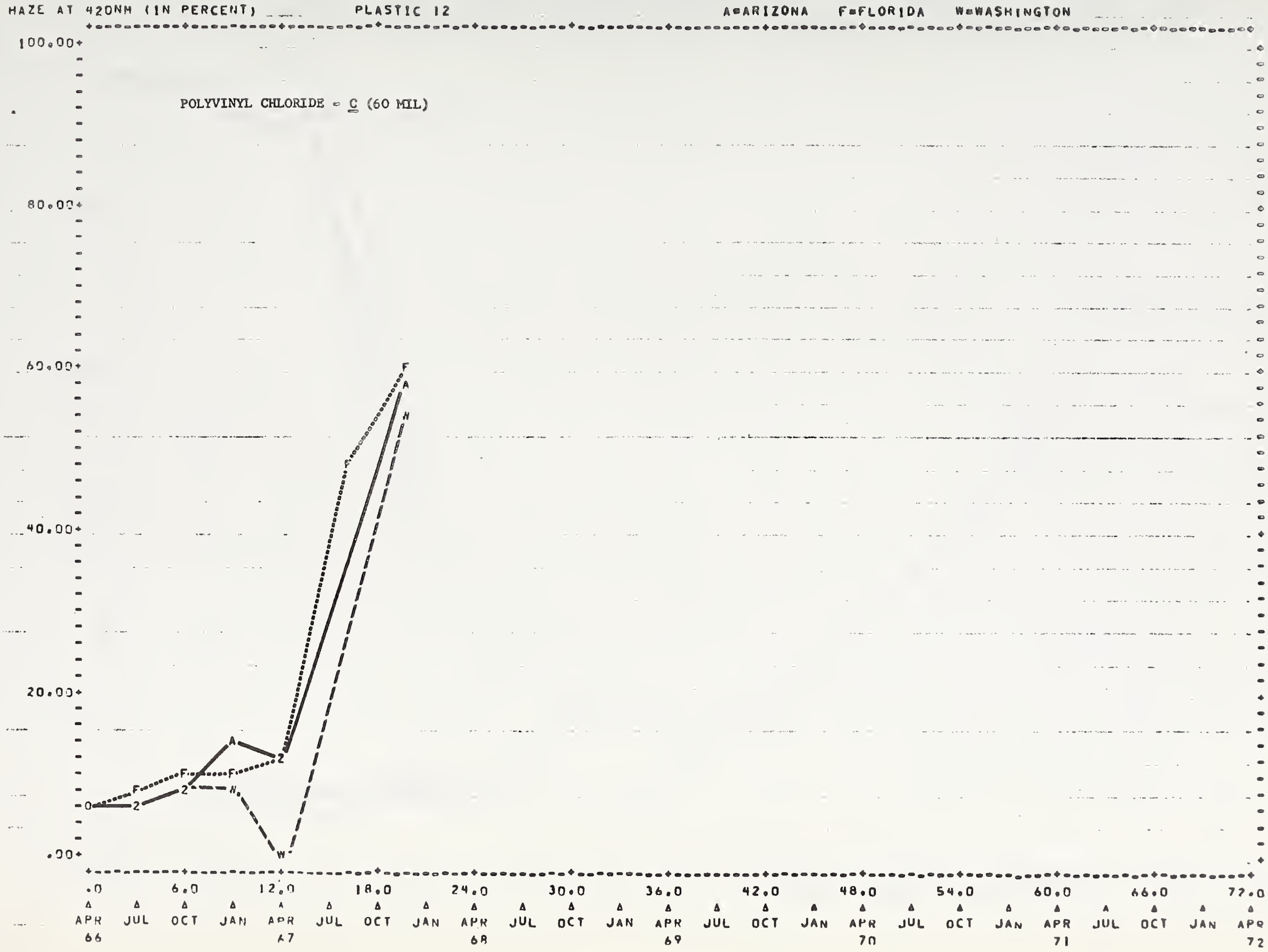

HAZE AT 550NM (IN PERCENT)
PLASTIC II
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - C (10 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 80A


HAZE AT 420NM (IN PERCENT)
PLASTIC 12
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - C (60 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
W
2
0

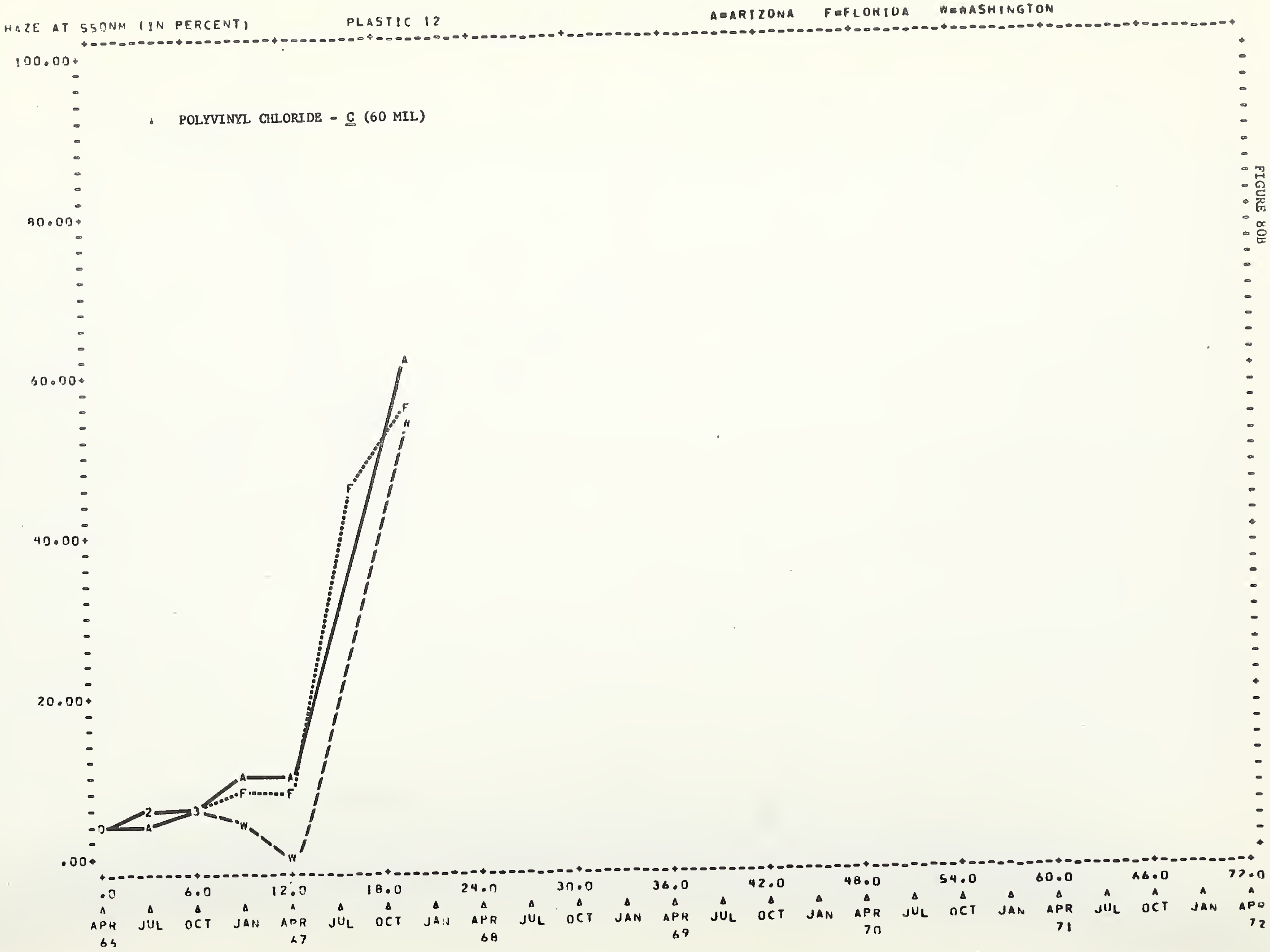
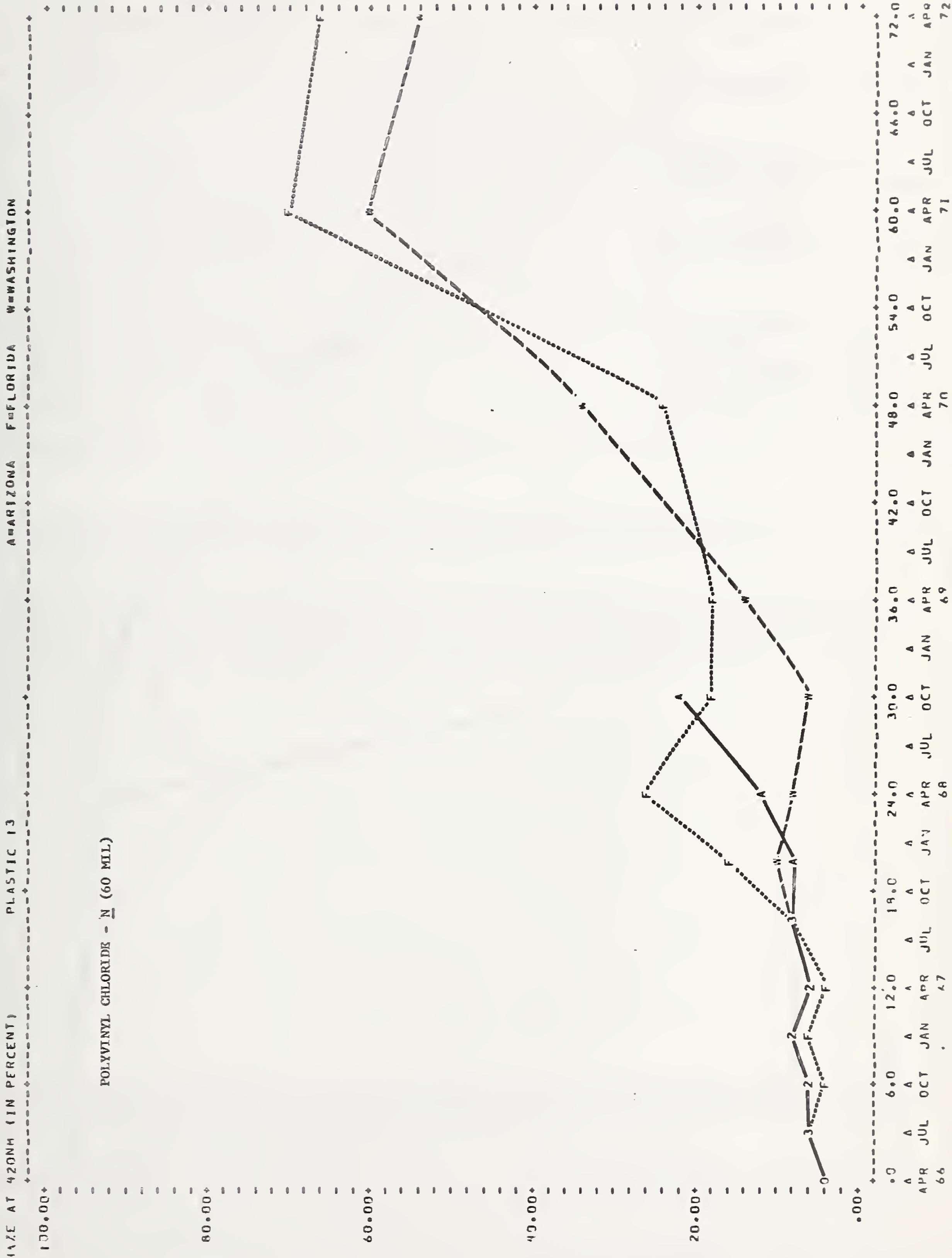
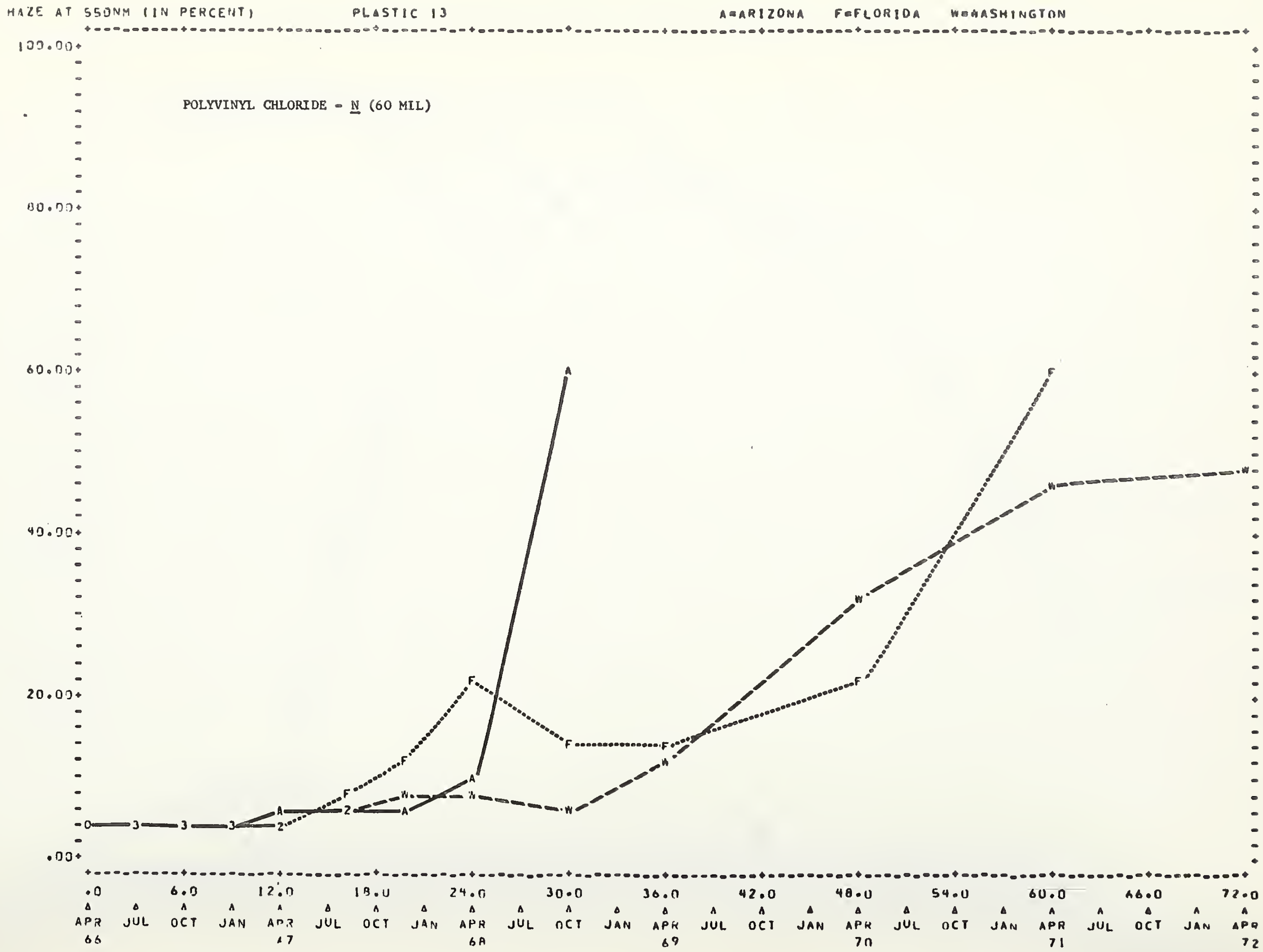

HAZE AT 550NM (IN PERCENT)
PLASTIC 12
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - C (60 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
OCT
JAN
APR 70
JUL
OCT
JAN
APR 71
JUL
OCT
JAN
APR 72
A
F
W
2
3
D

FIGURE 80B

FIGURE 81A


HAZE AT 420NM (IN PERCENT)
PLASTIC 13
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - N (60 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR JUL OCT JAN APR JUL OCT JAN APR JUL OCT JAN APR JUL OCT JAN APR JUL OCT JAN APR JUL OCT JAN APR
66 67 68 69 70 71 72


HAZE AT 550NM (IN PERCENT)
PLASTIC 13
A=ARIZONA F=FLORIDA W=WASHINGTON
POLYVINYL CHLORIDE - N (60 MIL)
100.00
80.00
60.00
40.00
20.00
.00
.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0
66.0
72.0
APR 66
JUL
OCT
JAN
APR 67
JUL
OCT
JAN
APR 68
JUL
OCT
JAN
APR 69
JUL
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APR 70
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JAN
APR 71
JUL
OCT
JAN
APR 72

FIGURE 81B

FORM NBS-114A (1-71)

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16. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)

Twenty plastics samples have been weathered in Arizona, Florida, and Washington, D. C. for 72 months. The weathering of these samples has been followed by measuring changes in the specimen's color, tensile, flexure, gloss, and haze properties. Computer-generated graphs of these changes with time are presented.

17. KEY WORDS (Alphabetical order, separated by semicolons) Manufacturing Chemists' Association (MCS); performance of plastics outdoors; plastics; weathering of plastics

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